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THE FOUNDRY

STANDARD "A measure of quality. A value established by general usage and consent—a definite unit of quality by reference to which other instruments may be tested; used to designate a very high or excellent kind or type"—*Webster*.

¶ By general usage and Consent the "Pangborn" Modern High Pressure Sand-Blast System has become **STANDARD**

There are many Reasons—see page 9

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THE FOUNDRY

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A FEW PROBLEMS IN MACHINE MOLDING

How they were successfully solved in a large stove plate shop where 169 molding machines of seven different types are operated

SUCCESS in molding machine operation depends, in large measure, upon the application of the work to the machine for which the latter is best adapted. A pattern may be so designed that it may be mounted upon a number of different types or machines, yet the output of one may far exceed that of the others, indicating that this machine is best adapted for this particular job. The secret of large machine-molding output lies in ascertaining the line of work that can be made to the best advantage on the various types of machines. This information is not always easily obtainable, as the personal equation is a factor that must be carefully considered, and a change of operators will frequently accomplish wonderful results, obviating the necessity of mounting the pattern on another machine, and not infrequently, changes in the pattern. It is, therefore, apparent that successful molding machine operation is by no means entirely dependent upon the machine, and it behooves the foundryman to study the problem carefully to obtain the best results.

The Best Foundry Co., Bedford, O., operates a stove plate shop, in which every pattern that can possibly be molded on a machine is so mounted. In the equipment of this foundry no special type of machine has been adhered to, as it was found that this would defeat the system of adapting the work to the machine, and, as a result, no less than seven different styles

FIG. 1—TWELVE FLOORS OF MOLDS, THE OUTPUT OF 12 MODERN MOLDING MACHINES AT 1:30 P. M.

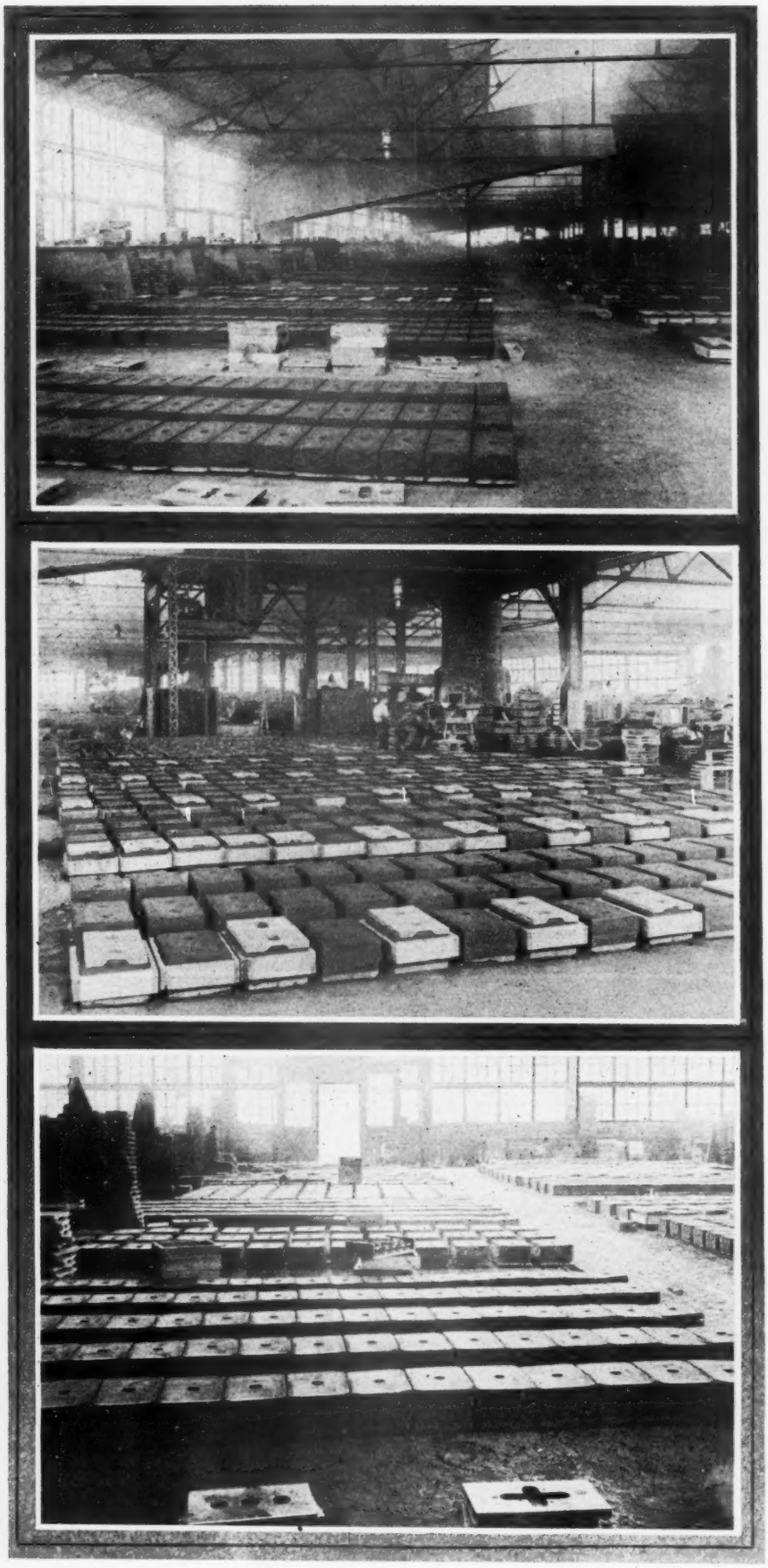


FIG. 2—SIX HUNDRED FEET OF FARWELL SQUEEZERS. THE PHOTOGRAPH OF THE FLOOR AT THE LEFT WAS TAKEN EARLY IN THE DAY

FIG. 3—THE OUTPUT OF FIVE PORTABLE FARWELL SQUEEZERS AT 11:40 A. M.

FIG. 4—THE OUTPUT OF 16 STRIPPING PLATE MACHINES AND SQUEEZERS AT 12:55 P. M.

of molding machines are in use. Nor are the large daily output records confined to any one type of machine, as it has been proven, that by the proper selection of work, the number of molds made daily compares favorably with the maximum rating of the machines. Among the stove foundries this shop takes first rank in labor-saving molding appliances, the total number of molding machines in use aggregating 169. The various types, and the number of each, follow: 35 pairs of rock-over machines, installed by the Osborn Mfg. Co., Cleveland; 10 power squeezers, Tabor Mfg. Co., Philadelphia; 21 Modern machines and one squeezer, Arcade Mfg. Co., Freeport, Ill.; 7 hand squeezer and pattern-drawing molding machines, Berkshire Mfg. Co., Cleveland; 5 pairs of stripping plate machines, Henry E. Pridmore, Chicago, and 90 Farwell squeezers, Adams Co., Dubuque, Ia.

Unskilled Labor.

All of the machines are operated by unskilled labor, which is paid on the piece-work basis. The ranks of the machine operators are recruited from the laborers about the plant, and until the workman has a fair knowledge of the operation of the machine and can produce a sufficient number of molds to net him a fair day's pay, he is on a wage basis. If, after a trial of several weeks, he is unable to produce a sufficient number of good castings to equal his wages, he is returned to the laboring gang. On the other hand, the amount he earns above his guaranteed wage is paid to him as if he were working on a piece-work basis. By this arrangement, the laborer learning to operate a machine is paid a higher wage than he previously received, and is also afforded an opportunity of earning more than his guarantee. This system has proven eminently satisfactory, and it is the ambition of the laborers to become machine operators.

Mounting the Patterns.

It need hardly be mentioned that the majority of patterns are in the form of plates with the patterns either on one side only, or on both sides of the plates, to suit the requirements of the machines on which they are to be used. Aluminum match-plates are used extensively, made of the pure metal, which have given as good service as any of the numerous aluminum alloys so frequently employed. The proper mounting of the patterns is another important factor that must be given careful consideration to insure the successful operation of molding

machines, and in this shop the mounting of patterns is of prime importance. With the exception of a few odd sections, which are still molded on the floor, follow-boards have been discarded almost entirely. The total number of gated patterns constantly in the storage vault and in use in the foundry totals 3,500. The daily output of the foundry averages 80,000 castings, weighing 65 tons, but the number of men employed is small as compared with this tremendous output of light work.

Large Output Per Floor.

To the average foundryman, the average daily output of some of the operators in this shop is not only considered improbable, but impossible. A high as 305 molds have been put up by one man in one day, with time to spare before the iron comes down. These high records are by no means exceptional, but almost every-day occurrences, and the floors have proven too small for the output of many of the operators. In Fig. 1 are shown 12 floors of molds made on Modern machines, built by the Arcade Mfg. Co., Freeport, Ill. This exposure was made at 1:30 p. m. and the operators had not yet finished molding for the day. One floor consists of 260 molds, and the operator made 300 before he stopped work to pour off. Another floor of gas stove grates, 11 x 19 inches, contained 235 molds, and the operator was compelled to stop molding when his floor contained 260 molds, as he had no further floor room.

Output of Squeezer Floors.

The floors at the left, Fig. 2, show the output of the stationary Farwell squeezers, installed by the Adams Co., Dubuque, Ia. These machines are located in a row and extend the entire length of one side of the foundry, 600 feet. This photograph was taken at 11:30 a. m., and only shows the floors partially filled. These squeezers are reserved for short orders and deep and intricate work, yet some of the operators produce as high as 150 molds per day. The average is approximately 115 molds, notwithstanding the fact that patterns are frequently changed, sometimes several times during the day. Five floors of molds, the output of five portable squeezers of the Farwell type, at 11:40 a. m., are shown in Fig. 3. These molds are for gas stove grates, 12 x 24 inches, and, despite their size, the operators average from 125 to 130 molds per day. Fig. 4 shows 16 floors of molds, the output of stripping plate

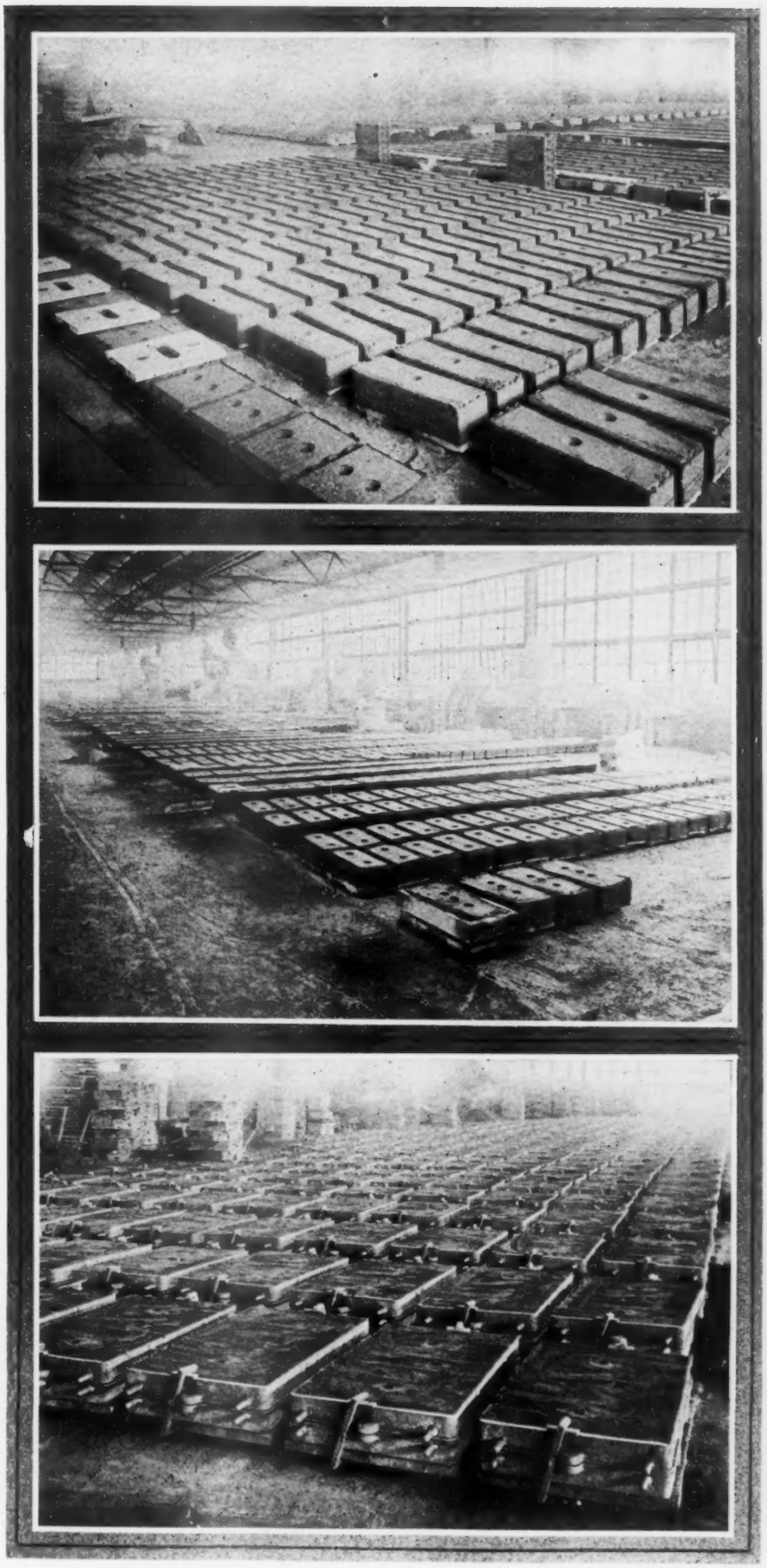


FIG. 5—A FLOOR OF 204 MOLDS, THE OUTPUT OF A PAIR OF PRIDMORE STRIPPING PLATE MACHINES, EQUIPPED WITH SQUEEZER HEADS; PHOTOGRAPH TAKEN 12:25 P. M.; 300 MOLDS CONSTITUTES A DAY'S WORK

FIG. 6—THE OUTPUT OF 10 TABOR POWER SQUEEZERS AT 12:35 P. M.

FIG. 7—THE OUTPUT OF FIVE PAIRS OF OSBORN ROCK-OVER MACHINES, 12:10 P. M.

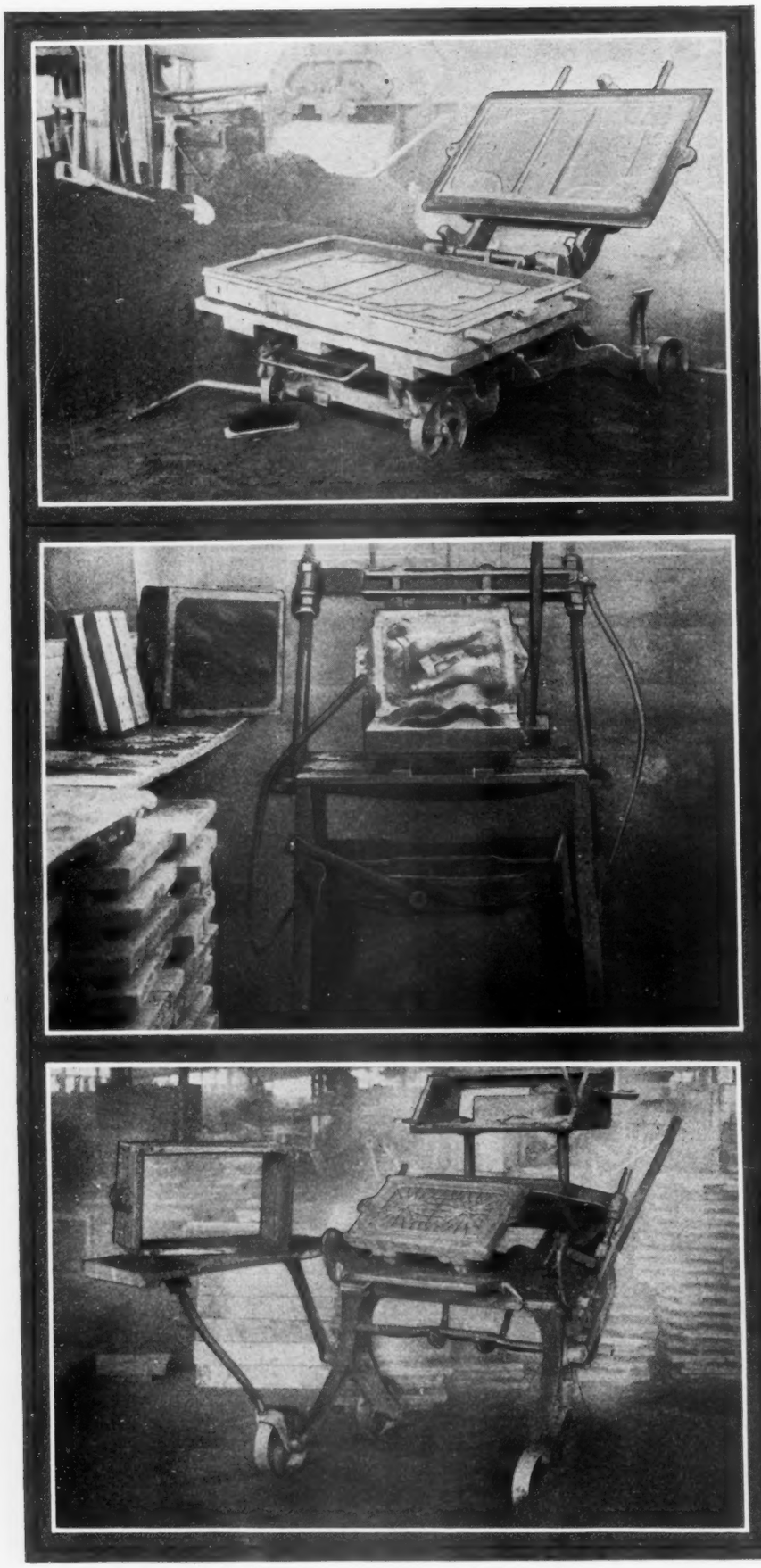


FIG. 8—OSBORN ROCK-OVER ON WHICH THE DRAG HALF OF A STOVE BASE IS MOLDED, IN A FLASK 25½ x 42½ INCHES

FIG. 9—BERKSHIRE HAND SQUEEZER AND PATTERN-DRAWING MOLDING MACHINE

FIG. 10—ONE OF THE PORTABLE FARWELL SQUEEZERS

machines and squeezers, as they appeared at 12:55. These floors average 120 molds per day, and this record of production is high considering the class of work made on these machines. Fig. 5 shows a floor of 204 molds, the output of a pair of stripping plate machines equipped with squeezer heads. The exposure was made at 12:25 p. m., and 80 molds were added to this floor before molding ceased for the day. The pair of machines, on which this work was done, is illustrated in Fig. 14, the drag being made on one machine and the cope on the other. In the center is shown a stand on which the mold is closed and the flask removed. The pattern plates contain a pair of stove burners requiring a core in each and the setting of 12 chaplets in each mold. The flask is 8 x 23 inches. This operator has employed a helper to assist him, and, considering the number of operations that must be performed in making a mold, the daily average is phenomenal.

Output of Power Squeezers and Rock-Over Machines.

The output of ten Tabor power squeezers at 12:35 p. m. is shown in Fig. 6. Fittings are made almost entirely on these machines, yet the floors average 130 molds, and as high as 200 molds have been made on these machines in one day. Fig. 7 shows the output of five pairs of Osborn rock-over machines at 12:10 p. m. The first floor contains 46 stove base molds, 25½ x 42½ inches, 70 molds constituting a day's work; on the second floor, 55 molds of stove tops have been put up, 28 x 30 inches, 78 constituting a day's work; third floor, stove tops 28½ x 30 inches, 63 molds, 82 per day; fourth floor, stove base, 27 x 31 inches, 60 molds, 90 per day; fifth floor, cook stove tops, 32 x 18 inches, 90 molds, 138 per day. Considering the size of the flasks the output is unusually large. These machines are operated in pairs, by two men, the molds being stepped-off.

One of the Rock-Over Machines.

One of the Osborn rock-over molding machines on which is mounted the pattern of a stove base is illustrated in Fig. 8. The drag is made on this machine and the cope is rammed on a stand. The flask is 25½ x 42½ inches, and 70 molds constitute a day's work for two operators. When made on the floor, 22 cents was the price paid for each casting, but this has been reduced to 12 cents on the machine, owing to the greatly increased output. When producing the drag half of the mold, the flask is set on the pattern

plate and the mold is stepped off by the operator. After clamping the bottom-board, the mold is rolled over and the bottom-board contacts with four equalizing posts. When the mold is leveled, the posts are locked, the clamps are removed from the mold, which is lowered away from the pattern. The pattern plate is then rolled back preparatory to making another mold. While one operator is making the drag the cope is being rammed on a stand, the mold being lifted from the pattern.

Hand Squeezer and Pattern-Drawing Machine.

Fig. 9 shows another type of molding machine successfully used in this foundry for molding stove plate. It is a Berkshire hand squeezer and pattern-drawing molding machine on which is used an aluminum match-plate for molding both cope and drag in one operation. The match-plate contains the patterns of two 7½-inch stove legs, and the flask is 12 x 16 inches. The daily output of one operator is 180 molds. After squeezing cope and drag, the pattern plate is vibrated and the pattern-drawing device raises the cope away from the pattern plate and the latter in turn is drawn from the drag. After lifting off the cope and removing the pattern plate, the mold is closed.

Portable Squeezers.

One of the portable Farwell squeezers is illustrated in Fig. 10. The pattern is a stove grate requiring a flask 12 x 24 inches and 6 inches deep. The average output for each operator varies from 125 to 130 molds daily. One of the Modern molding machines on which is mounted cope and drag match-plates containing the pattern for four back stove legs, is shown in Fig. 11. Cope and drag halves of the mold have just been made and the match-plates have been rolled back. The flask is 14 x 16 inches and 6 inches deep. The average daily output is 150 molds and the losses approximate only about 1 per cent. The operator, when pouring off his work must carry about 30 ladles of iron. On another machine of this type, one operator produces 260 molds daily, the flasks being 10 x 19 inches. Another operator on a similar machine produces 180 molds per day, and the flasks are 11 x 16 inches. The average daily output of all of the Modern molding machines, equipped for producing a miscellaneous line of work, is 170 molds.

Gas Stove Hot Plate.

Another Osborn rock-over molding machine, on which is mounted a pat-

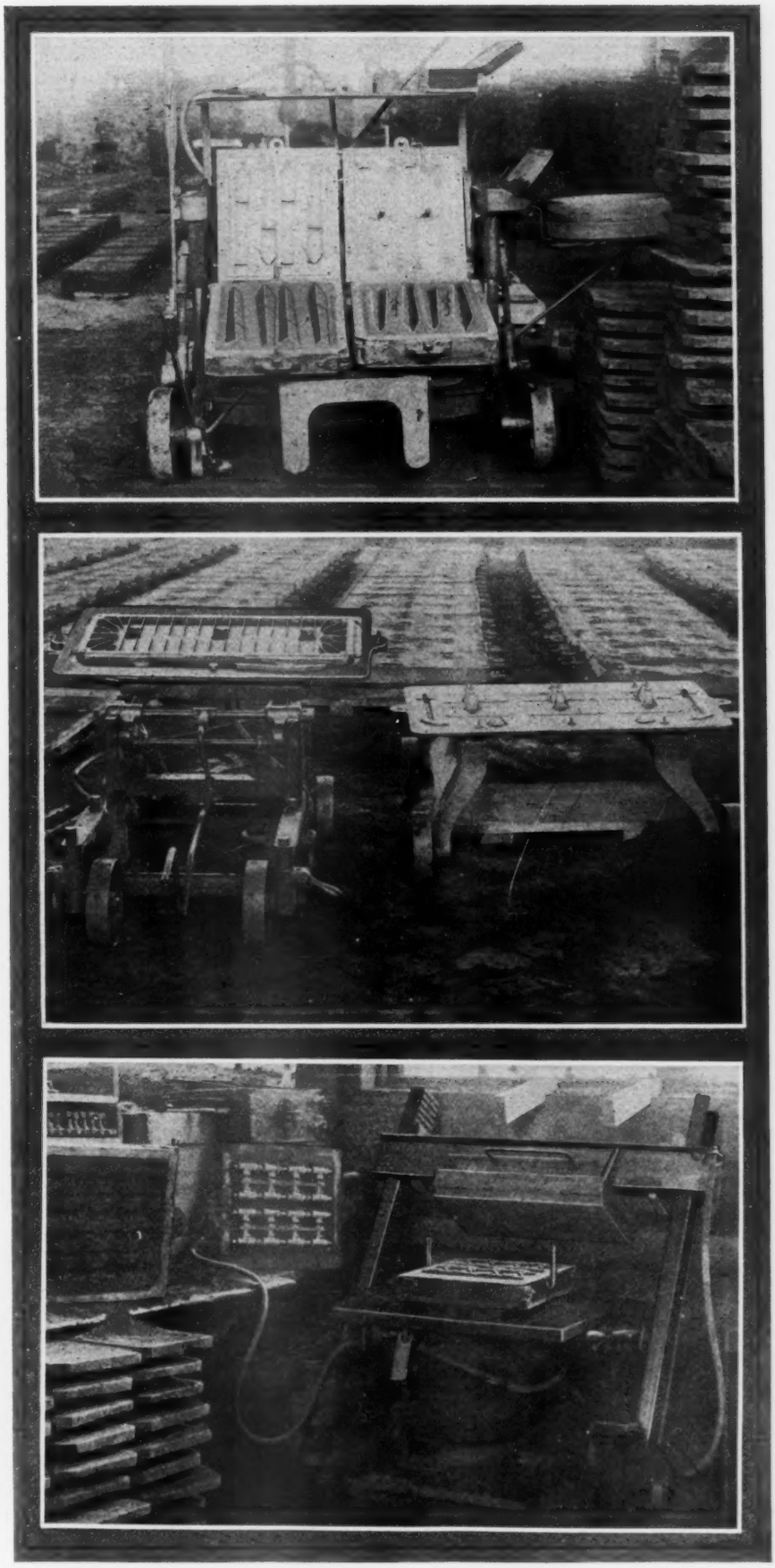


FIG. 11—ONE OF THE MODERN MOLDING MACHINES

FIG. 12—OSBORN ROCK-OVER MACHINE, WITH COPE STAND

FIG. 13—ONE OF THE TABOR POWER SQUEEZERS

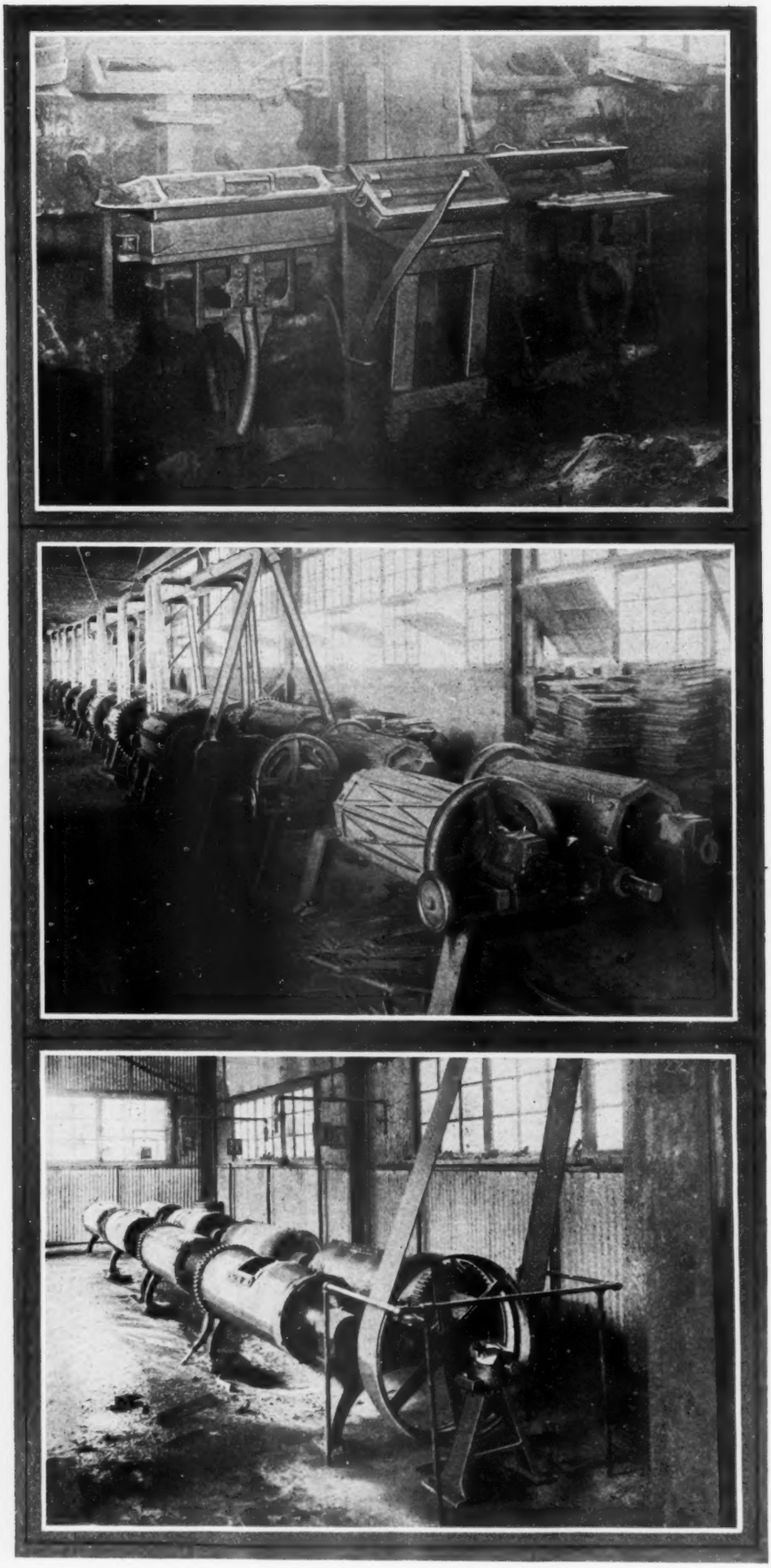


FIG. 14—PAIR OF PRIDMORE STRIPPING PLATE MACHINES, EQUIPPED WITH SQUEEZER HEADS

FIG. 15—A VIEW OF ONE SECTION OF THE TUMBLING ROOM

FIG. 16—THE BATTERY OF WET MILLS

tern plate for a gas stove hot plate, is illustrated in Fig. 12. This flask is 35 x 18 x 6 inches. The cope stand is shown at the right. It will be noted that the high parts of the pattern rise into the cope to a depth of 2 inches, and to prevent blowing, these parts of the mold are vented by wires extending through the pattern, and these vent wires are dropped before lifting off the cope by a lever at the front of the stand. The sand is not rammed over the high spots in the cope to prevent further blowing, as there is only 1 inch of sand over these points. Two operators produce 125 molds per day, and the cost has been reduced from 15 cents, when made on the floor, to 6 cents on the machine.

Power Squeezers.

A Tabor power squeezer is shown in Fig. 13. The flask is 14 inches square, and the plate contains the patterns of 16 small tees on two gates. Notwithstanding the extra labor involved in setting cores, the operator produces 125 molds per day. On another Tabor machine, round grates, two in a mold, are made in a flask 10 x 19 inches, and the average daily output is 200 molds. Fittings are principally made on Tabor machines, and the output per floor averages 135 molds. On none of the machines is hand-ramming permitted, and on the rock-over machines on which flat work is made the molds are stepped off.

Match-Plates.

A miscellaneous lot of match-plates is illustrated in Fig. 21. In the center are shown drag and cope match-plates of gas stove burner hangers made 12 in a mold. These plates are made of white metal and are used on the Modern molding machines. Another set of match-plates contains four stove legs and two aluminum plates, containing one and two stove legs each, are also shown. The large plates at the bottom of this illustration contain the patterns for two stove grids, the plate at the left making the drag half of the mold, and at the right, the cope.

Silica Sand Cores.

Silica sand is used almost exclusively for making cores for gas stove burners and other cored work. For certain cores the silica sand is mixed with varying proportions of bank sand to give body to the mixture. While silica sand is slightly more expensive than ordinary bank sand, it has been found that the amount of binder required has been greatly reduced, and the saving of oil more than offsets

the increased cost of the silica sand. In addition, silica sand cores vent more freely than those made of bank sand. To facilitate the making of the cores and setting them in the molds, multiple coremaking is resorted to. At *A*, Fig. 20, is shown one-half of a multiple core box in which eight tee cores are made. At *B* are shown three burner cores made in one core box, and at *C*, six burner cores made in one operation. A loop burner core on its dryer is shown at *D* and *E* is an intricate water heater coil core. At *A*, Fig. 22, is one-half of an iron oven burner core box and the core on its dryer is shown at *B*; *C* is a three-star burner core in its dryer and *D* is a large loop burner core in its dryer. All of the core boxes are made of gray iron and dryers are used for all of the cores. Whenever possible the vents are stamped in the cores before the two halves are closed.

Shop Order System.

The shop order system used in this foundry entails a minimum of labor, and, notwithstanding the tremendous amount of detail involved in following up the thousands of castings made daily, the clerical force is exceedingly small. A special foundry card, Fig. 26, is filled out for each order received. This card is 3½ x 8½ inches, and is perforated so that it can be divided into three sections. The part of the card retained by the molder until the order is filled is shown at *A*; *B* is retained in the pattern storage vault, and *C* is the order for the cores. On the molder's, as well as on the other two sections, are entered the name of the concern for which the castings are to be made, the date of the receipt of the order and other data, including the pattern number and description, pieces ordered, etc. It will be noted that 2,500 castings are required, and as there is only one casting on the gate, 2,500 molds will have to be made; the molding price is 5½ cents on a piece-work basis. On March 5 the molder produced 138 molds, and the same number was made on the following day. On each succeeding day the number of molds produced is added to the total of the preceding days, thus obviating the necessity of adding the number of molds made on this order to check the total production. On March 25 the total exceeded that called for in the order, but, owing to losses, the number of good castings required was not made until March 27, when the number of molds on this order aggregated 2,819. The order card was then stamped as being completed, and an-

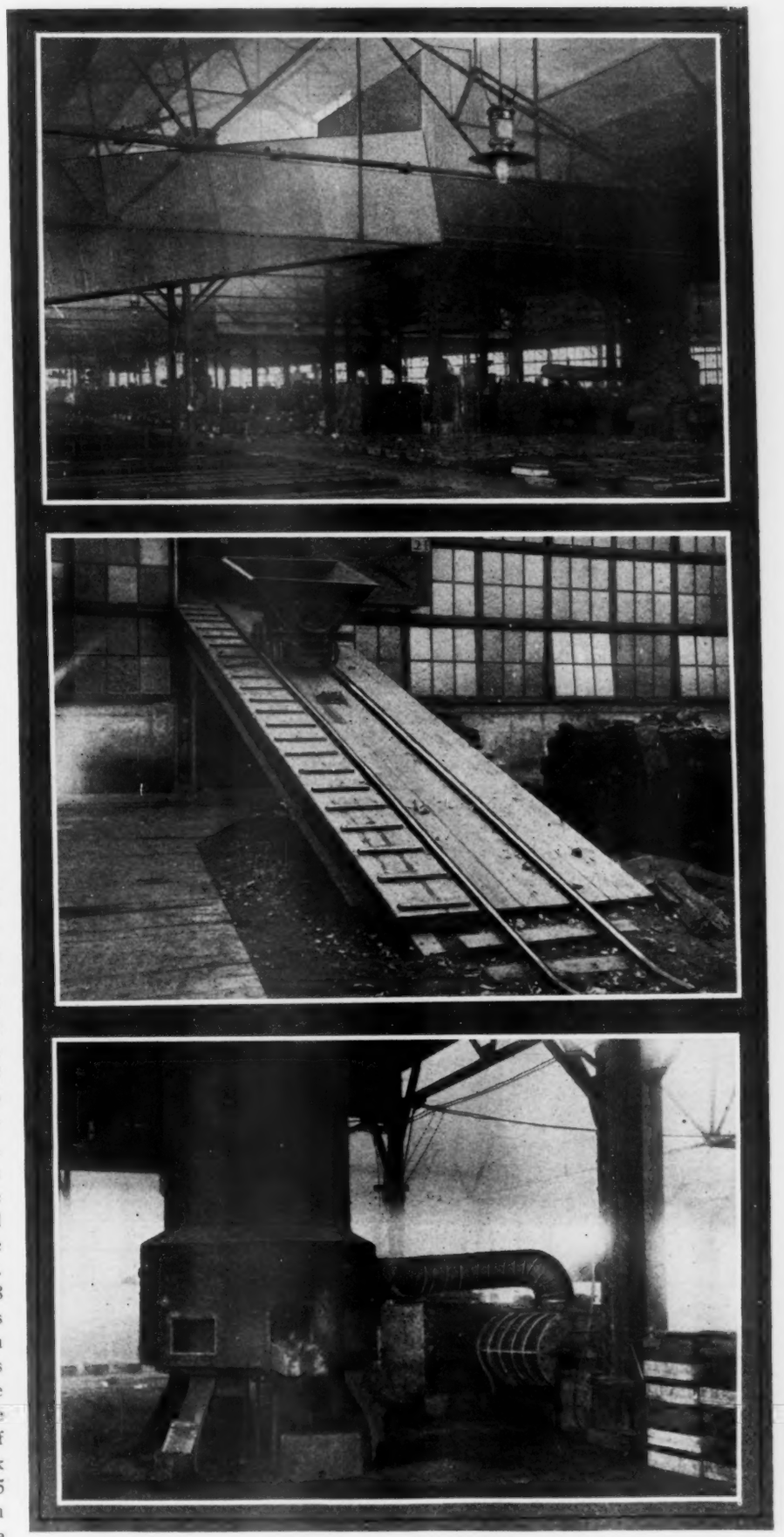


FIG. 17—VIEW OF ONE SECTION OF THE BEST FOUNDRY CO.'S PLANT, SHOWING INCLINE TO CHARGING FLOOR

FIG. 18—STORAGE YARD END OF INCLINE

FIG. 19—AN IDEAL ARRANGEMENT OF CUPOLA AND BLOWER

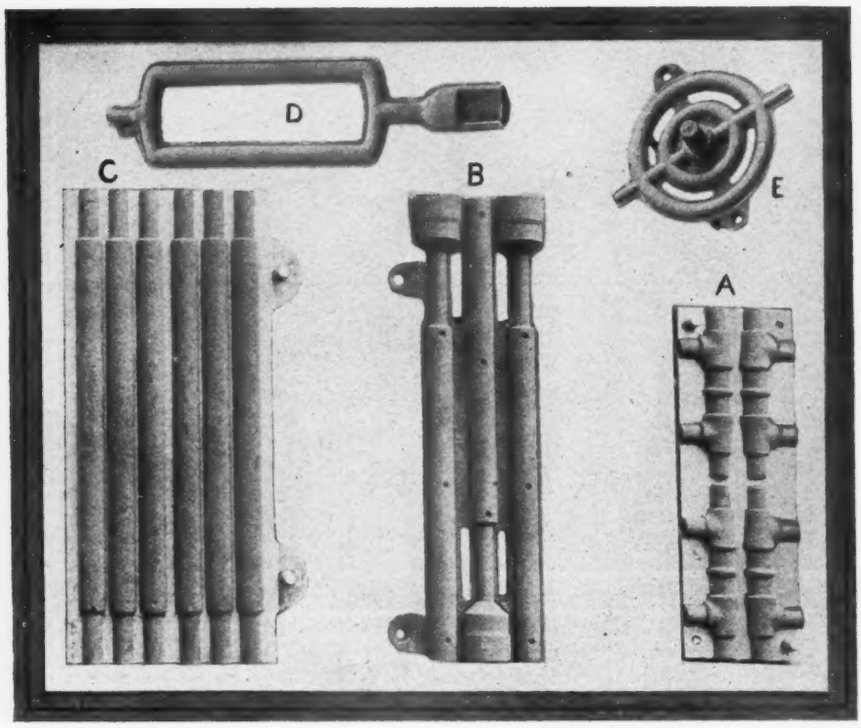


FIG. 20—GAS STOVE CORES AND METAL CORE BOXES

other order was given the molder, similarly filled out.

Timekeeper's Record.

For the office record of the number of molds made each day, and the number of good and bad castings, sheets as shown in Fig. 25, are filled out by timekeepers who pass through the foundry just before the metal comes down, and check up the number of molds made and also enter them on the molder's order card. These sheets are 9 x 16 inches, and contain spaces for the names of the molders, pattern number, name of the firm for which the work is intended, number of molds made, etc. After castings are cleaned the number of bad castings each day is entered, and the number of good castings produced is tabulated, as well as the total weight. With this information an accurate check can be kept upon the number of good castings produced and there is no danger of exceeding the total number called for, as the entire report covering the day's cast is tabulated the following day.

Pattern Storage Record.

The pattern storage record is simple and is in charge of the keeper of this department. All of the patterns, as well as the match-plates, follow-boards, etc., are stored in racks, suitably numbered, and their location in the vault is entered on the pattern storage card, Fig. 27. On this card is entered a complete description of the pattern, including the material of which it is made, number of gates and pieces per gate, weight per piece, cores and fitting required, core boxes and follow-board. The date of the receipt of the pattern is also entered, as well as the date when returned. By referring to this card the pattern storage keeper can tell at a glance whether the pattern is still in the possession of the foundry or whether it has been returned to the customer.

Layout of the Plant.

A plan view, showing the arrangement of the plant of the Best Foundry Co., is shown in Fig. 24. The foundry is 600 x 180 feet, an extension 200 feet long having been completed re-

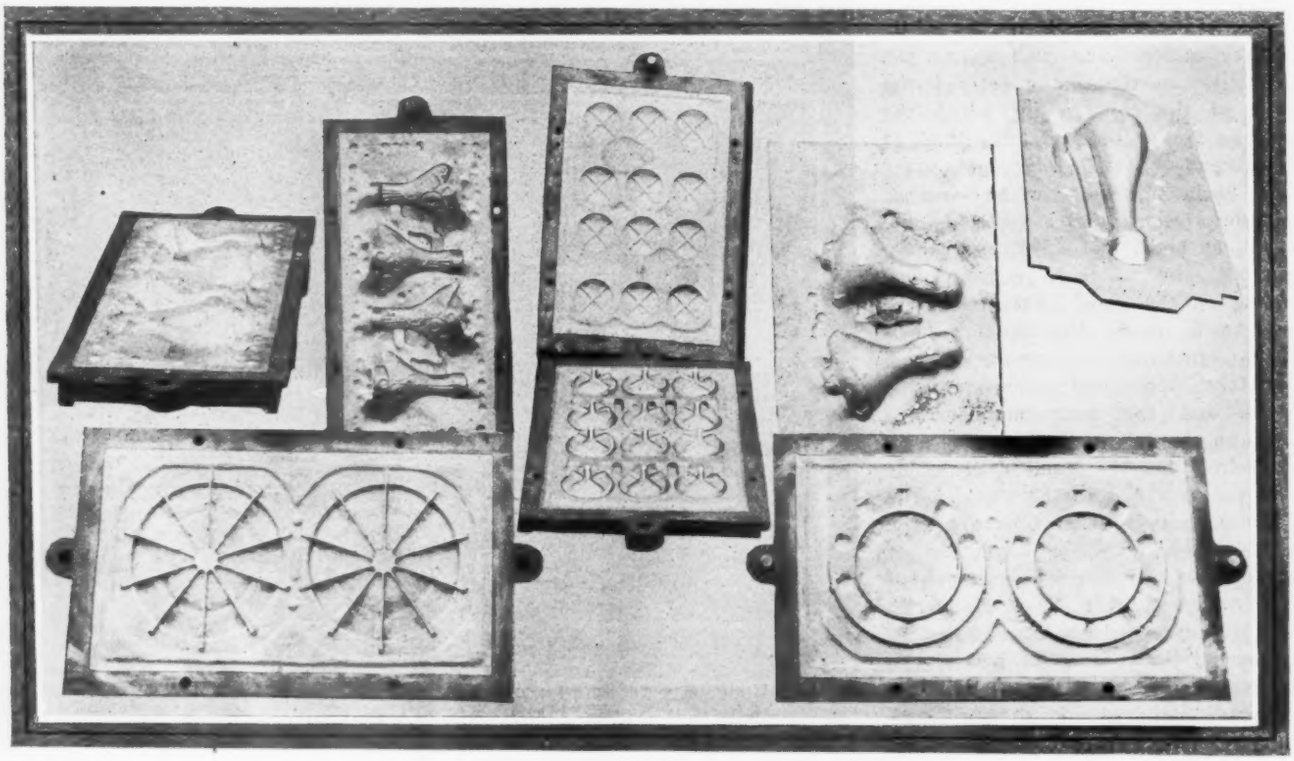


FIG. 21—ALUMINUM MATCH-PLATES FOR STOVE PLATE WORK

cently. It will be noted that three cupolas are located in a row in the center of the shop. This facilitates carrying-off, as the greatest distance to any point of the various floors is only 100 feet. No overhead metal carrying system has been installed, and it has been found that the work can be easily poured off with the cupolas arranged in this way. Paralleling one side of the plant is the pig iron storage yard, where the pig iron and coke cars are filled and delivered to the incline on narrow gage tracks for delivery to the charging floors. The carpenter shop and raw materials storage buildings are located on the opposite side of the railroad siding. Paralleling the opposite side of the foundry are the cleaning, finishing and shipping departments. The castings from the foundry are delivered to the tumbling mills in this building, where the grinders are also located. The stock room adjoins the finishing department, and in one end of the stock room are located the tapping machines and the plating tanks. The wet mills are in an adjoining building, to facilitate the shipment of the tumbled castings to the plating department. The cinder mill, galvanizing department and blacksmith shop are on the opposite side of the foundry, the railroad siding separating these departments from the storage yard.

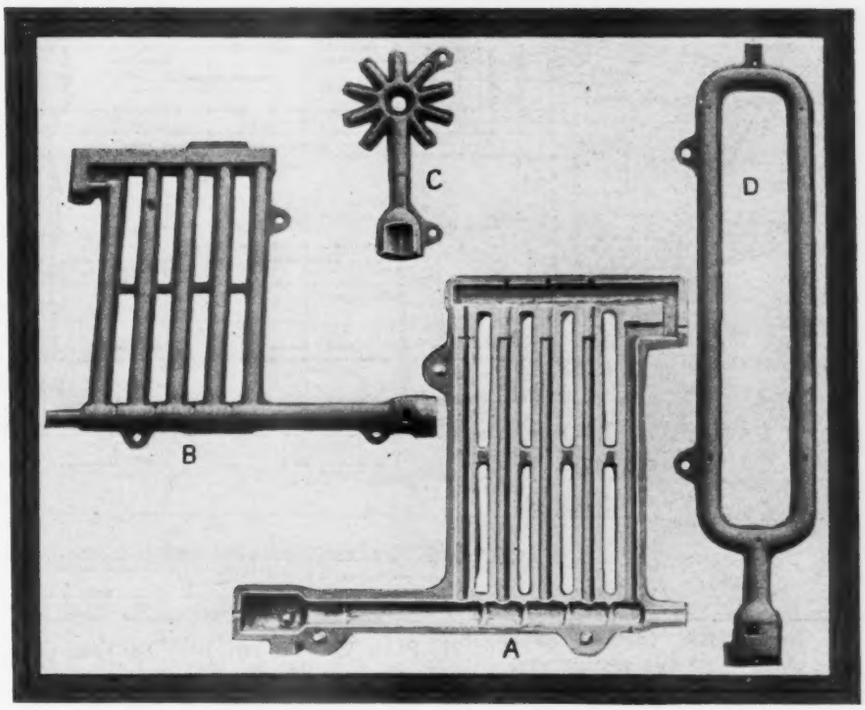


FIG. 22—LARGE CORES FOR GAS STOVE WORK

Two of the cupolas are lined to 78 inches and the third is 84 inches inside the lining. Blast is furnished by three Roots' blowers, installed by the P. H. & F. M. Roots Co., Connersville, Ind. The blowers are set on a foundation only slightly above the ground level, and the blast is carried only a short distance to the cupolas. This ideal arrangement is clearly shown in Fig. 19. The cupolas being located in different parts of the plant necessitated the erection of three charging floors to serve each furnace. Raw material is conveyed to the charging floors in cars drawn up by a rope haulage system, over an incline on which narrow gage tracks are laid. These inclines extend into the yard, as illustrated in Fig. 18, an empty car being shown in this view, on its return to the storage yard. An

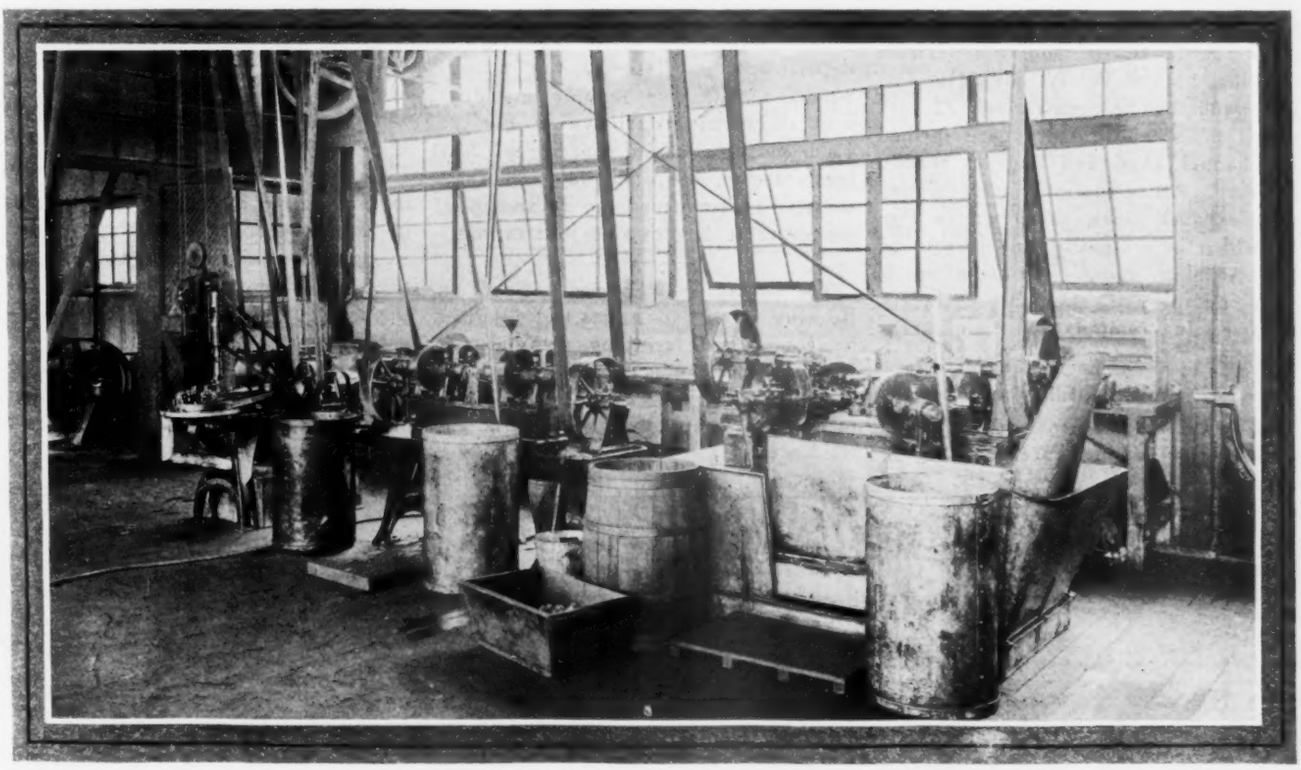


FIG. 23—THE DEPARTMENT IN WHICH THE GAS STOVE FITTINGS ARE TAPPED

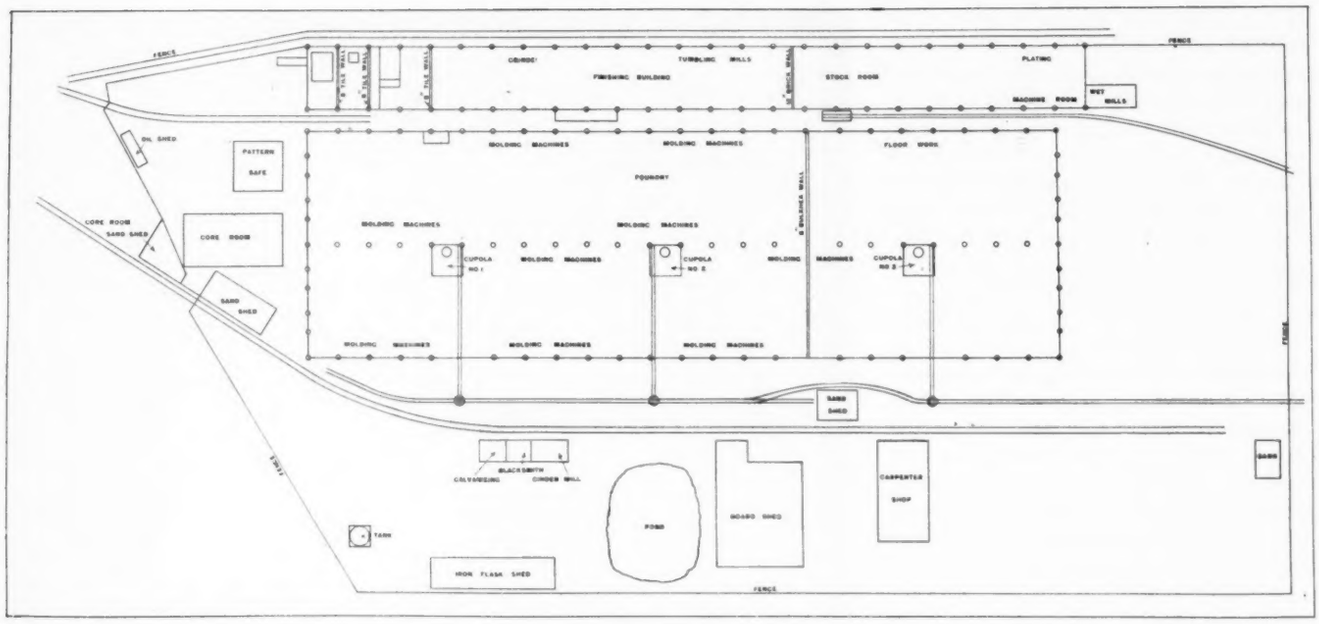


FIG. 24—PLAN VIEW OF THE BEST FOUNDRY CO.'S PLANT

interior view of one section of the foundry showing the incline leading to the charging floor, is illustrated in Fig. 17. The incline is entirely enclosed, to prevent material falling off the cars into the foundry. In addition, each charging floor is served by an electric elevator for carrying gates and sprues from the foundry to the charging floor, where the material is weighed and the mixtures are made.

Cleaning Department.

The casting cleaning department, located in a building paralleling the foundry, contains 44 tumbling mills, of which 12, of the square type, were installed by the W. W. Sly Mfg. Co., Cleveland. The remaining 32 are round mills whose staves are formed of channel iron, and can be readily replaced. All of the mills are equipped with exhaust pipes, as shown in Fig. 15, which is a view of one section of the cleaning room. In addition a large number of stationary grinders are used for removing fins and scars of gates.

Wet Mills.

To prepare gas stove fittings for plating, the castings are tumbled in wet mills, as shown in Fig. 16. These castings are first dry tumbled and are then charged into the wet mills, where they are tumbled for 30 hours with small pieces of sand stone, to give them a polished surface. The fittings are then tumbled in clear water for eight hours and are next rinsed in cold water. They are next dipped in a dilute solution of sulphuric acid and water, after which they are again rinsed in cold water and placed in the nickel-plating vat. After being plated the fittings are cleaned in hot water and after drying they are buffed.

This plant is also provided with a department for tapping the fittings, equipped with five tapping machines, four of which are shown in Fig. 23. Each machine has a capacity of 2,500 tees, elbows, etc., per day. The automatic tapping machine is shown at the extreme left of this illustration.

The Bristol Co., Waterbury, Conn., in Bulletin No. 124, illustrates and describes its atmospheric recording thermometers for recording outdoor temperatures, the recorder being installed indoors. These thermometers are extensively used in residences.

THE PATTERN DRAFT PROBLEM.

BY WILLIAM H. PARRY

TO ALLOW proper pattern draft on all patterns, whether they are to be used on molding machines, on the bench or on the floor, is the problem that some patternmakers do not seem to be able to solve. The old method of allowing "light under the square" on the drag half, and "twice that" on the cope, may be sufficiently definite for some patternmakers to work to, but this rule of thumb is so musty with age and so uncertain that in these days of progress it should be relegated to the rear. A more safe and sane method should be used to enable the molder to produce a fair day's work.

Only too often do we hear the remark in some jobbing shops, by those in authority, that "anything is good enough for the molder" and it is indeed unfair to this individual to slight the draft, if indeed any is put on the pattern at all.

On side frame patterns that are ribbed on both sides—and they are still designed this way—it is not unusual to find the same draft allowed on both

Piece Work for March 27 1910

No. on Gate	Hours	NAME OF MOLDER	Pattern No.	Firm	No. Molds Made	Bad Cast.	Blown Cast.	Broken Cast.	Good Cast.	Total Weight.

The Foundry

FIG. 25—TIMEKEEPER'S RECORD SHEET

ORDER COMPLETE 4-27-10

Molder's Order

Owner S P T

Date 3-17-10

Pattern Number and Description 286 F

Pieces Ordered	Molds
2500	2500

Pieces per Gate	Gates per Mold
1	1

Price 5½c

Molder A. Verbosky

DAILY REPORT

Date	Molds	Date	Molds	Date	Molds
5	138	18	1756		
6	276	20	1894		
7	414	21	2032		
8	552	22	2170		
9	690	23	2305		
11	828	25	2543		
12	966	26	2681		
13	1104	27	2819		
14	1242				
15	1480		A		
16	1618				

IN SAND

Owner

Date

Shelf No.

Pattern Number and Description

Pcs. Ordered	Molds

Pcs. per Gate	Gates per Mold

Price

Molder B

Core Order

Owner

Date

Pattern Number and Description C

Pieces Ordered

The Foundry

FIG. 26—MOLDER'S CARD, PATTERN STORAGE STUB AND CORE ORDER

drag and cope, even though the cope ribs are fastened. It is true that patterns such as deep, flat backs, that are not too large, can be drawn out of the sand with only a very small draft allowance, and such patterns convey the idea to apprentices that this rule is a good one to follow when making almost any pattern, figuring that such patterns have no cope lift. A sure cure for the disease known as "back draft" is at least a year's service in the foundry by all patternmaker apprentices, and many journeyman would profit by such experience.

On patterns for molding machine work it is necessary to provide what in some cases would be considered excessive draft, such as on ribs, bosses, pockets or lugs, which do not happen to be on the stripping edges of stripping plate machines, and which, from the nature of the work, must clear the sand. Furthermore, the same principle applies to patterns mounted on roll-over machines, as abundant draft should be provided so that the mold will drop away clean. Patterns, either wood or metal, should be sand-papered or filed in line with the draft to minimize the possibility of the sand adhering to the patterns.

SEMI-STEEL FOR LIGHT WORK.

By N. W. SHED

Question:—I would like to have some information regarding the melting of semi-steel. My work is largely light, consisting of castings for fans and blowers, and will, therefore, carry only a small percentage of steel. I mold about three tons per day, the cupola being 42 inches in diameter. I would like to know how the steel is charged and what per cent to use. I would like to use up the steel scrap in our yard, and any further information on the melting of semi-steel will be appreciated.

Answer:—Semi-steel can be used for light work, but the metal must be poured very quickly and large gates and risers should be used. It is not advisable to use over 20 per cent steel scrap and very good results are obtained with 10 or 15 per cent of steel. The steel for small work should be in the form of boiler plate clippings, ¼ inch to ⅜ inch thick, and is preferably used in sizes 1 foot square or less, or in triangular pieces which may be about 18 inches long. Steel punchings can also be used, but these should not be placed in the middle of the cupola. The steel plate scrap is usually spread out on the coke and the pig and other iron scrap on top. The ferro-manganese is charged on the steel.

A 2,500-pound charge for a 42-inch cupola would be made up as follows: Coke, 300 pounds; steel scrap, 500 pounds; pig iron, 1,500 pounds; cast iron scrap, 500 pounds; ferro-manganese, 25 pounds.

The coke bed should be sufficient to insure the first iron coming hot. The pig iron should contain about 3.50 per cent silicon, 0.50 to 0.80 per cent phosphorus, and 0.60 to 0.80 per cent manganese. It is good practice to have the metal high in manganese, from 0.65 to 0.90 per cent. However, good iron is made with manganese below 0.50 per cent. The main point in making semi-steel is to have the metal hot, and it should be tapped into small ladles, taking the metal directly from the spout, and poured quickly.

This metal gives good results for ordinary work. If a very tough, hard iron is desired the silicon and phosphorus must be reduced, but such metal is difficult to pour in light work. It would be a good plan to try a 10 per cent steel mixture, and if the metal is not sufficiently dense, experiment with 15 or 20 per cent of steel in the mixture.

3

PATTERN NO.	NAME	CUSTOMER DANGLER

DESCRIPTION OF PATTERN		RECEIVED			SHELF NO.	RETURNED		
MATERIAL		MO.	DA.	YR.		MO.	DA.	YR.
NO. OF GATES								
PIECES PER GATE								
WEIGHT PER PIECE								
CORES REQUIRED								
FITTING REQUIRED								
CORE BOXES								
FOLLOW BOARDS								

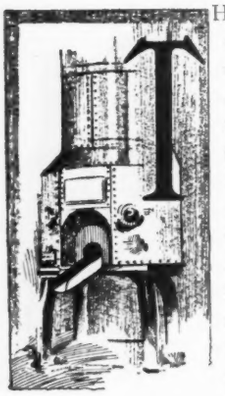
The Foundry

FIG. 27—PATTERN STORAGE CARD

CHEMISTRY AND CUPOLA PRACTICE*

A discussion of the relation of the chemist to the foundryman --- Causes of variations in physical and chemical properties of gray iron

By W. W. COX



THERE are certain characteristics which iron coming from a cupola must have in order to make castings that are sound, that are capable of being easily machined and that possess average tensile strength; in other words, satisfactory castings. Since the advent of coke iron in the foundries it has been shown by practical usage that the ordinary foundry mixture usually produces an iron strong enough for ordinary purposes if the mixture has been properly melted in the cupola, if it contains the correct proportion of metalloids within rather wide limits and if it is cast at the right temperature.

Failure of Castings.

It is perhaps a broad assertion to say that if a casting is solid and easy to machine, it has tensile strength enough for ordinary machinery castings; yet there are few records of castings that have failed in service that have not shown some flaw or defect which accounted for the failure. It is a metallurgical fact that, if castings are solid and contain normal percentages of the elements usually present in the iron, the castings will have tensile strength enough for ordinary use, approximately 20,000 pounds per square inch. It must not be inferred that it is not possible to produce castings of much higher strength by proper mixing and melting of irons capable of producing it.

Problem for the Foundry Chemist.

The ordinary problem, therefore, before the foundry chemist, is to produce sound castings that can be easily machined. In a casting of this character, the carbon must be largely in the graphitic state, or rather, the per cent of combined carbon should be 50 per cent or lower, as the facility with which cast iron can be cut or machined depends entirely upon the amount of combined carbon in it. Following are the averages of a series of test bars drilled with Keep's hardness machine, which shows the number of revolutions of a standard 3/8-inch drill required to penetrate the 1 x 1-inch test bars, the drillings from which were afterwards used for making the carbon determination:

		Combined carbon, per cent.
No. of revolutions.....	569	0.51
No. of revolutions.....	844	0.76
No. of revolutions.....	413	0.41
No. of revolutions.....	275	0.13
No. of revolutions.....	451	0.48
No. of revolutions.....	363	0.18

As all machinery castings are machined, it is evident that the combined carbon should be kept as low as possible. The question arises, if the combined carbon is low, say 0.15 per cent, would not the tensile strength be impaired? This might be answered by saying that the per cent of combined carbon (or just carbon, for it is all combined) in wrought iron is nearly always below that quantity, while the tensile strength is always greater than ordinary cast iron.

Graphite.

Graphite of course is a weakening element, and if separated in the metal in sufficient quantity to accumulate as "kish," it would reduce the tensile strength to practically nothing. Nevertheless, a very small quantity of combined carbon serves to give strength to the casting as shown by the following analysis of pig iron which has the highest tensile strength of any iron produced in the United States: Graphitic carbon, 2.55 per cent; combined carbon, 0.155 per cent; silicon, 0.78 per cent; sulphur, 0.027 per cent; manganese, 0.565 per cent and phosphorus, 0.244 per cent.

Castings having combined carbon 1 per cent and over, are not only hard to cut but are brittle and are apt to be unsound. In order to produce good machinery castings of an average thickness of 1½ inches, the chemist should mix and melt iron producing the following analysis: Graphitic carbon, 2.60 per cent or less; combined carbon, 0.50 per cent or less; silicon, 2.00 to 2.30 per cent; sulphur, 0.100 per cent; manganese, over 0.40 per cent and phosphorus, below 1.00 per cent.

Semi-Steel.

In mixtures in which steel scrap is an ingredient, called semi-steel, the metalloids would be reduced as the percentage of steel is increased. The carbon is not reduced proportionately, however, as the metal absorbs more or less carbon from the fuel, depending upon whether it was melted in a neutral or oxidizing atmosphere in the cupola. Neither is manganese reduced in proportion, as ferro-manganese has to be added to diminish the sulphur, for which this kind of a mixture has a strong affinity, and to keep the carbon in the graphitic form in the casting.

The above analysis represents what some old-fashioned foundrymen make occasionally and what the foundry chemist should make continuously, or nearly so, for machinery castings of a certain section.

Variation in Cupola Practice.

An example of the variations in cupola practice and the results obtained, are shown in the following four heats, which were made in the same cupola, and with the same mixture and blast pressure. From the first, middle and last of each heat was cast a 1 x 1-inch test bar from which these analyses were made:

Heat No. 1.

	Graphitic carbon per cent.	Combined carbon per cent.	Silicon per cent.	Sulphur per cent.	Manganese per cent.	Phosphorus per cent.
First bar.....	2.54	0.52	2.00	0.103	0.45	...
Middle bar.....	2.18	0.80	2.05	0.128	0.37	0.95
Last bar.....	1.70	1.23	1.97	0.196	0.34	...

The iron was hot at first and cold at the end of the heat. The castings from the beginning of the heat were strong, sound and easy to cut. Those from the middle of the heat were not so good and the castings from the end of the heat were brittle, spongy and hard to machine.

*Read before the Western Branch of the American Chemical Society, May 21.

The iron was hot but melted slowly near the end of heat No. 2. The castings from the first part of this heat were hard and brittle while those from the middle and last of the heat were of good quality.

Heat No. 2.

	Graphitic carbon per cent.	Combined carbon per cent.	Silicon per cent.	Sulphur per cent.	Manganese per cent.	Phosphorus per cent.
First bar	1.67	1.28	2.05	0.136	0.35	...
Middle bar	2.65	0.52	2.10	0.105	0.45	0.92
Last bar	2.78	0.42	2.10	0.109	0.45	...

In heat No. 3 the iron melted rapidly throughout the heat but was not very hot. The resulting castings were neither soft nor very strong.

Heat No. 3.

	Graphitic carbon per cent.	Combined carbon per cent.	Silicon per cent.	Sulphur per cent.	Manganese per cent.	Phosphorus per cent.
First bar	2.41	0.71	2.01	0.118	0.41	...
Middle bar	2.40	0.72	2.00	0.119	0.42	0.90
Last bar	2.44	0.70	2.02	0.105	0.40	...

In No. 4 the iron melted rapidly and was hot throughout the heat. The castings were strong, free from defects and easy to machine.

Heat No. 4.

	Graphitic carbon per cent.	Combined carbon per cent.	Silicon per cent.	Sulphur per cent.	Manganese per cent.	Phosphorus per cent.
First bar	3.10	0.42	2.27	0.102	0.56	...
Middle bar	2.85	0.38	2.18	0.117	0.52	0.92
Last bar	2.70	0.42	2.13	0.115	0.45	...

The explanation of these wide variations in the chemical analysis and physical properties of the castings produced from the same iron mixture lies in the fact that the iron was melted at different levels in the cupola. It was Edward Kirk who found by experiment that iron could be melted properly only in a certain part or zone in the cupola, that the zone was usually about 8 inches in depth and that the height of this melting zone above the tuyeres depended upon the velocity of the blast.

In the case of heat No. 1, the bed coke was 34 inches above the tuyerers when the first iron was charged and the fuel between the charges was not sufficient to replenish the bed as it burned away, consequently the bed kept getting lower and lower throughout the heat. The first iron was melted in the center of the melting zone and the last iron was melted in the lower edge of the zone where it was hardened by the oxidizing atmosphere.

In heat No. 2 the bed was 50 inches above the tuyeres when the first iron was charged. This excess of coke had to be burned away in order to allow the iron to descend to the point where it could be melted, the iron meanwhile being heated to a high temperature for a considerable period and burned much as a grate bar is burned. A grate bar, when re-melted, shows high combined carbon. The remainder of this heat was melted at the proper height in the cupola, which, not being slagged and containing an excess of coke ash, melted slowly.

Heat No. 3 is an illustration of false economy in coke. The iron was melted low in the zone throughout the heat, the bed being 12 inches above the tuyeres when the first iron was charged and enough fuel was used between the charges to maintain that height during the heat.

The last case, heat No. 4, shows the mixture melted at the center of the melting zone during the entire heat, with a 34 inch bed and a melting ratio of 1 to 8½ for the charges and yields the maximum strength, softness, soundness and uniformity, and other qualities that the mixture is capable of producing.

Convertible Foundry Flasks

By OSCAR E. PERRIGO

A LARGE majority of iron foundries find it necessary to do more or less jobbing work, while many of them handle a product that possesses, to a marked degree, most of the characteristics of jobbing work. As every foundryman realizes, there are many troublesome conditions involved in handling any kind of jobbing work, and many difficult requirements are insisted upon by the customers for whom such work is produced.

One of the prolific sources of trouble and expense is the problem of suitable flasks for the great variety of sizes and forms of work desired. However liberal the foundryman may have been as to incurring the necessary expense of flasks, there still seems to be a demand for more.

If we look over the flask yard of almost any foundry where jobbing work is done, we find hundreds of flasks piled up in a more or less orderly fashion, representing a good many dollars in cost, from which expenditure there is relatively a small return, when the interest on the investment is considered.

Expense of Flasks.

Nor does this condition seem to be improving to any considerable extent, so far as handling the problem is concerned and, on the other hand, the continual increase in the price of lumber is rendering the question of expense more and more important and burdensome.

While it is true that there a large number of cast iron flasks in use, which serve their purposes admirably, it is altogether probable that for some time a majority of the foundry flasks will continue to be constructed of wood.

In order to remedy these conditions, we must first realize their importance and consider their effects. In this case they seem of sufficient importance to demand some well-directed effort for their improvement.

These results may, to a considerable extent, be realized by the use of the system of convertible flasks herewith described, and by which methods the number of flasks required for the successful operation of the foundry may be reduced and the expense for equipment and maintenance materially lessened.

Convertible Flask.

The system consists essentially of building-up the flask of the required dimensions by means of component parts, such as sides, ends, cross bars, etc., by the various possible combinations of which, flasks of many different dimensions and proportions, may be readily assembled.

Fig 1 shows a perspective view of one of these convertible flasks, assembled and ready for use. It is set up for a flask 48 inches long, 32 inches wide, and 9 inches deep. Fig. 2 is a plan and side elevation of the flask, showing its construction. Fig. 3 shows the method of producing a deep flask

by the use of two flasks of moderate depth. Similar reference letters are used for like parts in the several views.

Construction of Convertible Flasks.

In Fig. 2 the side pieces have three grooves at each end as at *a, b, c,* to fit end pieces, 2 inches thick. The side and end pieces are rigidly secured to each other by means of the cast iron lock plates, *C, D,* which are securely bolted to the side and end pieces, respectively. The contact faces of these lock plates are slightly inclined or wedge-shaped, by which form they are rendered rigid when forced into proper position with relation to each other. They are secured from unlocking by the bolt, *E,* which screws into a nut set in the end piece. By means of the grooves, *a, b* and *c,* the end pieces, *B B,* may be readily shifted from one position to another when it is desired to change the length of the flask. Holes are provided at *d, d,* for the bolts holding the lock plate *C,* when it is shifted to accommodate the end piece, when moved to either the groove *b* or *c.*

At *f, g* and *h* are grooves in the side pieces *A* for accommodating the cross bars *F, G, H.* These are usually considerably thinner than the side and end pieces in this size of flask, generally 1 inch thick. These bars are secured in place by bolts screwed into nuts set in the cross bar as previously described. If a cross bar is to be placed in one of the wider grooves, as at *c,* the end of the bar is increased in thickness by the addition of a cleat, *e.*

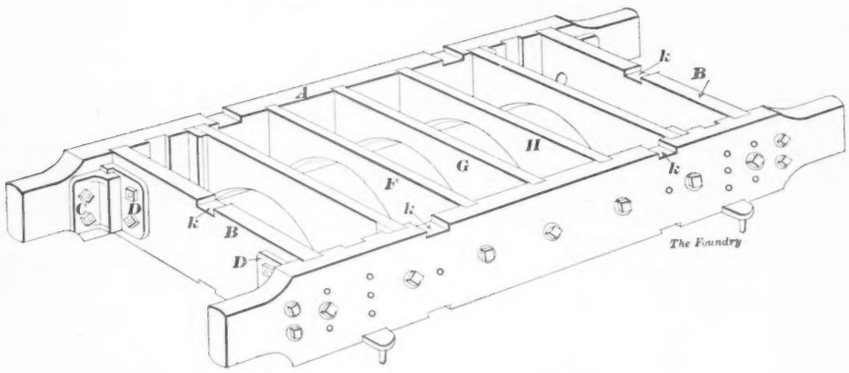


FIG. 1—PERSPECTIVE VIEW OF CONVERTIBLE FLASK

Varying Length of Flask.

By this construction we have a flask that can be readily converted to the following lengths inside; 48, 44, 40, 36 or 32 inches. By having on hand, end pieces and cross bars, of the four lengths of 18, 22, 26 and 30 inches, we are able to produce any of the following sizes:

Inches.	Inches.
18 x 32	26 x 32
18 x 36	26 x 36
18 x 40	26 x 40
18 x 44	26 x 44
18 x 48	26 x 48
22 x 32	30 x 32
22 x 36	30 x 36
22 x 40	30 x 40
22 x 44	30 x 44
22 x 48	30 x 48

All of these flasks however would be of a uniform depth of 9 inches. In Fig. 3 is shown a method of joining two or more flasks by means of the clamp bars, *K,* secured by lag screws or bolts, as desired. These clamp bars may be of wrought iron, the ends being bent at right angles to fit the grooves *k, k,* or they may be made of cast iron, correspondingly heavier and thicker, for the same purpose. These clamps are usually placed on the side pieces of the flask, but if the flask is quite large and deep they may be also placed on the end pieces.

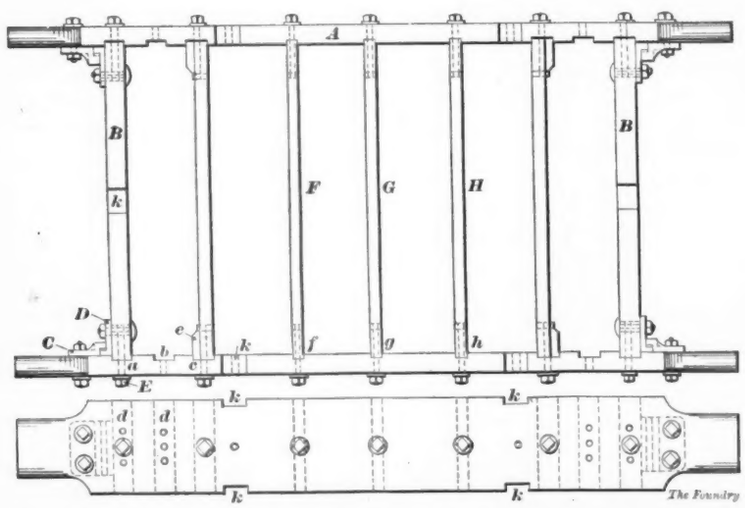


FIG. 2—PLAN AND SIDE ELEVATION OF CONVERTIBLE FLASK

By making standard side and end pieces of a depth of 6 to 9 inches, we may provide flasks of five different depths, as follows; 6, 9, 12, 15 and 18 inches, using but two pieces in the combinations.

Combinations.

If now we consider the 20 flasks of different dimensions as specified above and the five different depths here provided, we shall have 100 combinations that may be produced by the component parts described. These will consist of the following parts: Two pairs of side pieces, 6 and 9 inches wide; 10 pairs of end pieces, 6 and 9 inches wide, and in pairs of 18, 22, 26 and 30 inches long; 10 sets of cross bars, 6 and 9 inches wide, and of same length as the end pieces.

It will be readily seen that this method of construction will result in great economy when it is considered that in addition to the saving of lumber and the first cost of making the equipment, the necessary changes to any required dimensions may be easily made by the foundry apprentices or the laborers.

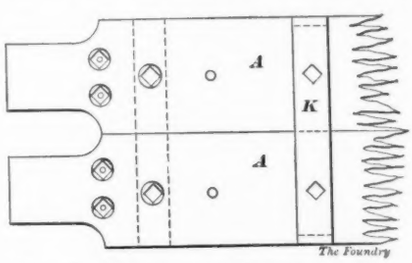


FIG. 3—METHOD OF FORMING A DEEP FLASK

Economies Effected.

The above dimensions are given as illustrations, but seem sufficient to show what could as easily be accomplished with any given set of relative dimensions that might be necessary to accommodate the work of any particular foundry.

Economy in storage space is also effected in that the component parts necessary for a large number and a large variety of sizes of flasks can be stored in a much smaller space than is the case with flasks made up in the usual manner. By classifying the various component parts by dimensions, they can be readily stored in an orderly manner and much time is saved in finding just what is wanted.

CRUCIBLE STEEL CASTING PROCESS---II

Design and construction of furnaces for melting crucible steel for casting purposes --- Analysis of the mixture

By CARL SMERLING

STEEL founders are somewhat slow in making changes in their melting departments. This is natural, because of the expense and uncertainty attending such efforts, and to this fact is due the extensive use of the obsolete pan system of using oil in melting crucible steel. It has been demonstrated that such furnaces will melt steel, and produce good work, the great objection being their expense compared to furnaces burning heavy refuse oil and atomizing the same by means of a suitable burner. Longitudinal, plan and cross section of a furnace, in which burners are used, are shown in Fig. 1.

Four burners are provided, two at each end of the furnace, the upper two doing most of the melting, while the lower burners, which are smaller, are used to preheat the combustion chambers *A A*. This arrangement is of material assistance in quickly raising and maintaining the temperature of the furnaces. The flame travels through the furnace and passes out through the parts, *B B*, to the flue, *C*, to the stack. The flue, *C*, is provided with a damper to regulate the draft, while the covers, *D*, span the melting chamber and are provided with peep holes, so the progress of melting can be observed.

The advantage of this furnace over the pan type is that it melts quicker and the oil consumption is less, but like all furnaces where the flue passes under the melting chamber, the repairs are both frequent and expensive, and it is doubtful if any saving is effected over the other types of furnaces previously considered.

Another Crucible Furnace.

Fig. 2 shows another type of furnace recently adopted by several concerns with good results. This furnace is built for 8, 12 or 14 pots. Only one burner is used, which is placed at *A*. The air for combustion, supplied by a blower, also enters at *A*. The mingled air and oil unite in the combustion chamber, *B*, and the flame travels through the melting chamber, *C C*, to flue, *D*, and thence to stack. The damper, *E*, is provided to regulate the draft, and covers, *G G*, span the melting chamber, inclosing two crucibles each. The covers are provided with the customary peep holes. The slab, *H*, is used to close the gap at the end of the furnace covers. Some steel melters consider an abutting wall an advantage in this furnace, the wall being pierced by two flue holes, on a level with the top of the crucibles, but the writer has not found this to be the case.

The bottom of this furnace is made of crushed coke and crucibles, and in operation, the forward half of the charge melts first and is drawn and poured, the remaining crucibles being moved forward, and charged cold pots put in their places. This furnace is more economical than any thus far described, as the output is larger, oil consumption less and the crucibles last longer.

A burner using oil at a pressure of

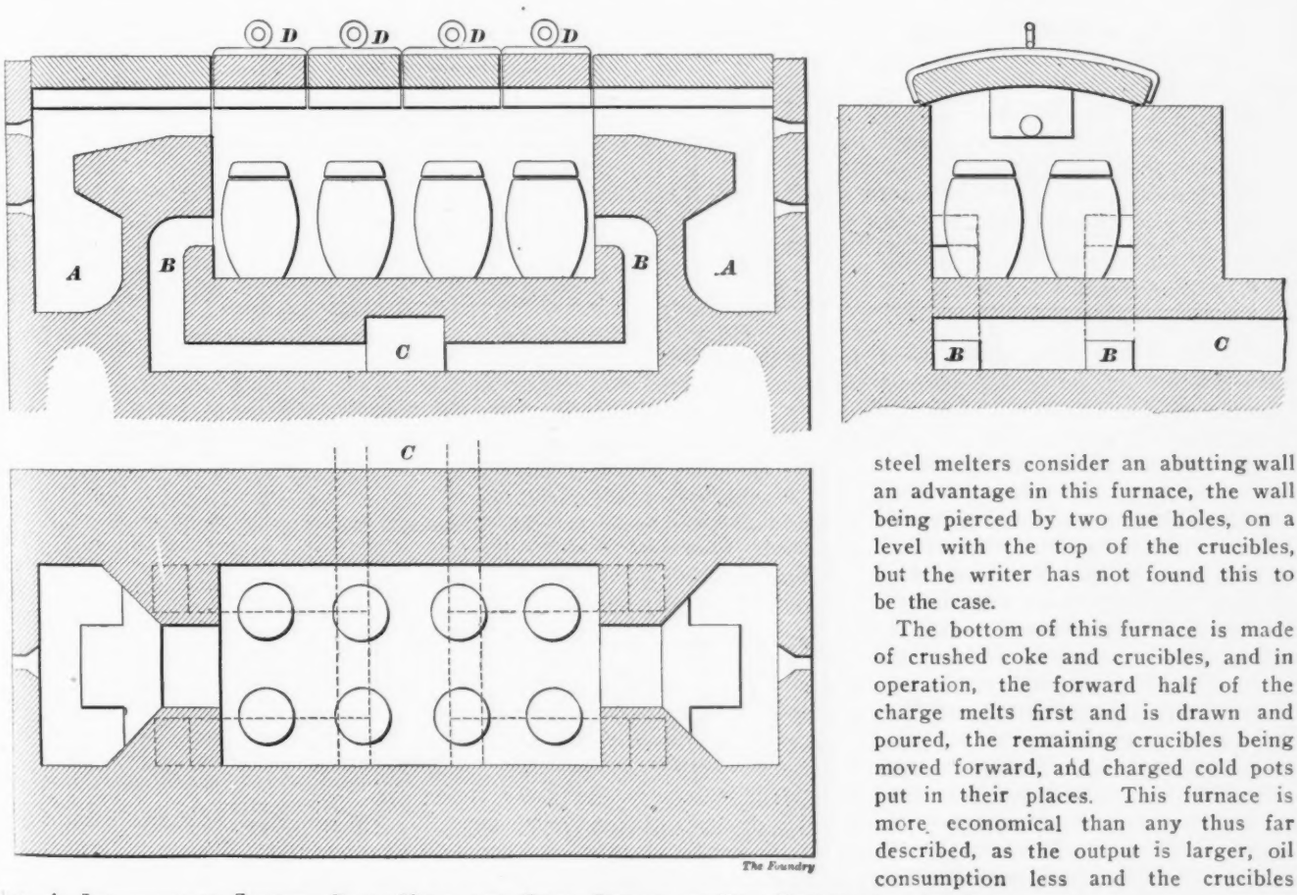


FIG. 1—LONGITUDINAL SECTION, PLAN VIEW AND CROSS SECTION OF FOUR-BURNER CRUCIBLE STEEL MELTING FURNACE

from 10 to 20 pounds, and air at 20 to 40 pounds, has proved satisfactory when using heavy refuse oil, weighing from 7 to 8.5 pounds per gallon. The type of burner is not so important as its relation to the size of the furnace. The burner must be fitted to the furnace, as a large burner in a small furnace, or vice versa, could not be expected to work to advantage. Low pressure burners, which atomize 15 to 30 gallons of oil an hour, are not suitable for this furnace, as the spray does great damage to the pots, such burners being more suitable for drying and heating ladles, or for other purposes where a low temperature will suffice.

Crucibles.

Soft steel is very hard on the pots, and they will not last long. This is because of the intense and prolonged heat. The life of a pot also depends largely on the good judgment of the operator, as well as on the quality of the material melted. When a crucible becomes thinner on one side than on the other, the melter should always replace it in the furnace with the thin side turned from the flame. If the charge runs high in manganese, from 0.45 to 0.60 per cent, this manganese will attack the crucible and will reduce the thickness of the walls. As a result, not more than two heats per pot are frequently obtained.

Analysis of Materials.

It is absolutely necessary to purchase all materials by analysis, and the manganese may range from 0.25 to 0.35 per cent, the latter amount being the maximum allowable, as the crucibles will suffer and the steel will not be up to standard. In testing new crucibles to secure a fair average test, it is necessary to try out at least twelve, and they must be thoroughly dry before being placed in the furnace. The cutting action of the slag at the slag line is due to the large percentage of manganese in the steel passing into the slag and attacking the graphite in the crucible. In making a very low carbon steel, the crucibles are sometimes lined with a siliceous lining, but this does not prolong the life of the pot. A better method of making low carbon steel is to use a crucible that has been used two or three times before and to melt muck bar.

The life of the crucible can be prolonged, however, by washing the inside, particularly at the slag line, with bauxite or kaolin after each heat. These clays are used in the manufacture of crucibles. Both clays are silicate of alumina, which is very refractory and to a large extent prevents the absorption of carbon from the pot, thus prolonging its life.

Melting Material.

The material commonly used in crucible steel foundries is boiler punchings, mostly from ¼ to ½ inch boiler plate. The chief reason for using punchings is because they pack readily in the crucible. When boiler punchings cannot be procured, either because of prohibitory freight rates or scarcity of material, a good substitute is horse nail scrap, which makes good, low carbon material. The composition of the melting material should be approximately as follows: Carbon, 0.12 to 0.18 per cent; manganese, 0.25 to 0.35 per cent; phosphorus, 0.04 per cent, and sulphur, 0.04 per cent.

Final Additions.

It will be noted that the silicon is not taken into consideration, which is due to the fact that it has practically passed out of the steel entirely, and into the slag by the time the metal is melted. When scrap material of the foregoing analysis is used, the final additions are as follows: 80 per cent ferro-manganese, 0.82 per cent; 50 per cent ferro-silicon, 0.88 per cent; aluminum, 0.015 per cent. These additions are made only when the scrap is practically free from oxide of iron.

Low carbon steel when in a molten condition very readily absorbs gases such as oxygen, hydrogen and nitrogen, and when the metal is cast and solidifies, these gases change their form and attempt to escape, but generally fail, as the solidification takes place too quickly, and the castings are full of blow-holes. The most frequent cause of blow-holes is oxide of iron, therefore great care should be exercised to keep it out of the charge, and if the punchings are heavily oxidized or rusted, they should be either sand-blasted or tumbled before being used.

The principal elements used as deoxidizers are silicon, manganese and aluminum, the first two being the most important, as they possess a strong affinity for oxygen and prevent red-

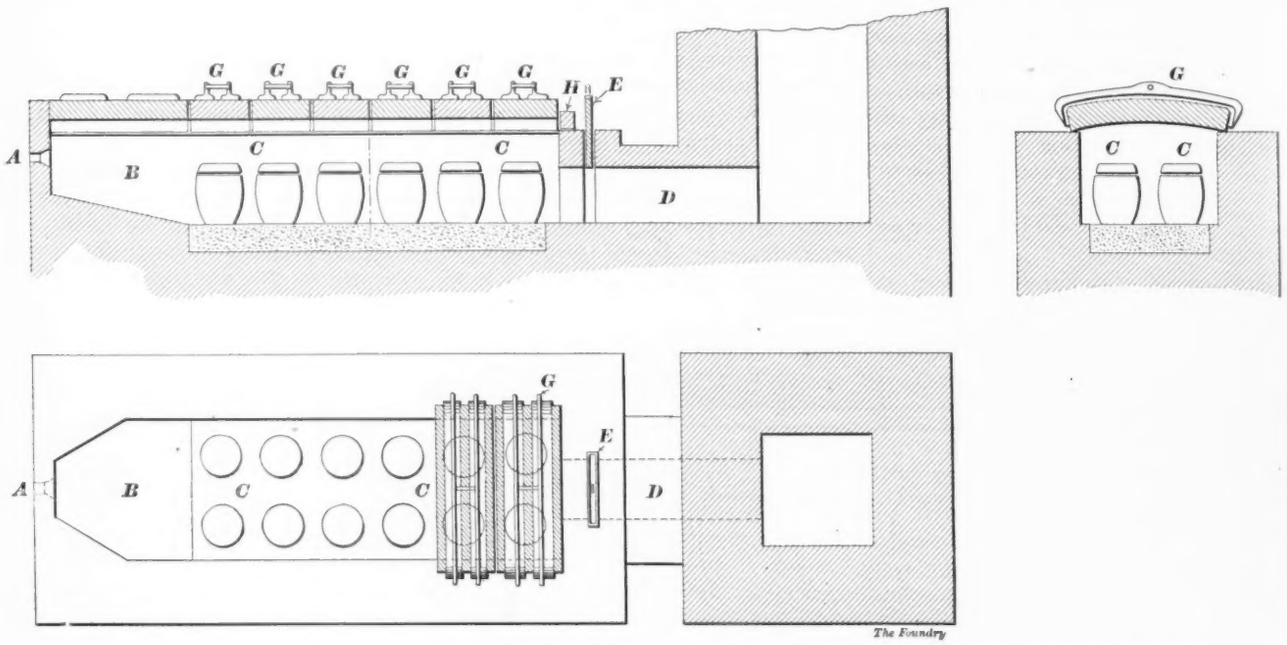


FIG. 2—LONGITUDINAL SECTION, PLAN VIEW AND CROSS SECTION OF 12-POT, CRUCIBLE STEEL MELTING FURNACE

shortness and blow-holes. Silicon, alone, has a peculiar effect on molten steel, as it apparently increases the capacity of the metal for retaining occluded gases. Silicon and manganese, together, form an easily melted manganese silicate, which unites with oxygen in the oxide of iron, thus preventing the formation of carbon-monoxide, which is the cause of blow-holes in steel. Hydrogen and nitrogen are always present in molten steel, as they are absorbed from the furnace gases. This can be largely prevented by covering the pots. A part of these gases are expelled in cooling, but some may be retained, forming blow-holes or small cavities, which can be found by heating the steel in a vacuum.

Aluminum is added principally to low carbon or soft steel, when it is not desirable to use sufficient silicon or manganese to effect its complete deoxidation. It must, however, be used with care. While it will reduce the oxide of iron, its union with oxygen forms alumina, which is extremely refractory and is distributed througout the steel in infinitely small particles, which separate the crystals, thus reducing the tensile strength and elongation. Aluminum in large quantities tends to pipe and deepen the shrink-holes, therefore, it is expedient to use as little as possible to effect the elimination of surface pin holes. The writer has found an addition of 0.01 to 0.04 per cent sufficient when the melting practice is good, and good material is melted.

About 20 years ago the Mitis Steel Co., in Europe, placed on the market a cartridge as a medicine or physic for steel. This cartridge was supposedly filled with ferro-manganese, ferro-silicon and aluminum in proper proportions, but it was found that this did not give good results, as the aluminum melted first and becoming oxidized passed into the slag as alumina. This necessitated the use of these materials in a different manner.

The use of high grade ferro-silicon and ferro-manganese has been of great assistance in crucible steel manufacture, as they save both time and material, and also prolong the life of the crucibles.

Charcoal is sometimes used to increase the carbon content, a stick of dry pine being occasionally used for this purpose. An alloy containing 50 per cent iron and 50 per cent carbon, is particularly effective for recarburizing. The use of such fluxes as potassium, ferro-cyanide, common salt, oxide of manganese, etc., is frequently resorted to. The oxide of manganese and the salt may have a tendency to thin the slag, while the ferro-cyanide presumably favors the absorption of carbon by the slag.

The Shockless Jarring Machine*

By WILFRED LEWIS

THE jarring machine is essentially a sand-packing machine, capable of ramming any mold, large or small, in a minute or less time. By the method employed, the sand is rammed, as it should be, densest at the surface of the pattern and of decreasing density above, thus favoring the escape of gases when the mold is poured. The packing of the sand results from impact between the table on which the mold is carried and the anvil on which it drops. Various means may be used to lift the table and let it drop, but in foundry work compressed air has come to be generally preferred for its convenience as a medium for the transmission of power, and also for the simplicity of the machines resulting from its use. The jarring machine is not universal in its application, nor should it be used without judgment and discrimination. Due regard must be given to the construction of the pattern so as to permit a flow of sand chiefly in one direction, and to withstand successfully the shock of impact in ramming. But, for the broad field of work adapted to its use, there is nothing comparable to the jarring machine as a saver of time and money.

*Presented at the Spring meeting of the American Society of Mechanical Engineers, held at Atlantic City, May 31—June 3.

Development of Machine Molding.

Jarring machines have been in practical use for many years without attracting much attention. The records of the patent office go back to 1869; but like all other types of molding machines, they have never been made, until quite recently, for large, heavy work beyond the strength of one or two men to handle. It was quite natural that the molding machine should begin its development in a small way on small work; as the field has widened it has been seen that the possibilities for saving time and money in the foundry have increased with the size of the work adapted to machines.

Anyone who has watched a bench molder fill his little flask, ram it in a few seconds with a butt rammer in each hand, then roll it over and draw the pattern with the dexterity of an artist in legerdemain, can appreciate the difficulty of helping him in his work by any mechanical means. Yet the old-fashioned hand squeezer saved some of the ramming time, and the power squeezer saved a little more, but not so much in time as in the strength of the operator, keeping him fresh, with steady hand and eye, for the delicate work of drawing patterns and setting cores. Pattern guides were then devised to assist in drawing patterns, and vibrators were invented to free the pattern from the sand without appreciably enlarging the mold.

Machines for Small Work.

The use of molding machines on small work has resulted in a substantial saving in the cost of molding, less wear and tear on patterns, and greater uniformity in castings, the saving in weight of the castings due to the use of a vibrator being sometimes an item that soon pays for the installation of the machine.

The hand squeezer is, of course, limited in its application to what can be done at one effort by one man, and for larger work, power squeezers have generally been employed; but when large molds are squeezed by power, more or less trouble is encountered in the distribution of pressure on the sand. At one time an effort was made to overcome this difficulty by means of a water bag placed between the sand and the squeezing head. Better results were obtained,

however, by judicious tucking in deep pockets, by heaping the sand over deep places, and by scooping it out over high points in the pattern; but the main difficulty in squeezing deep molds lies in the fact that the sand is generally moved against the pattern instead of the pattern against the sand. This results in the greatest density of sand being away from the pattern, next to the squeezing head, and not where it should be, next to the pattern.

Bottom-Ramming Machines.

As shown by Harris Tabor's experiments,[1] presented to this society in 1892, the friction of sand on the sides of a deep flask may carry a large part of the pressure on the squeezing head. To avoid this difficulty, bottom-ramming machines have been employed, which move the pattern against the sand, but this method contemplates a definite, predetermined movement of the pattern to produce a mold of the density desired, and is subject to variations not easily controlled. Bottom-ramming has, therefore, not been adopted to any great extent, and power squeezers have usually been limited in application to flasks not more than 2 to 3 feet on a side by a foot deep. Such machines, when designed also for pattern-drawing, are comparatively expensive and have marked for a time the limitations of machine molding.

During recent years, however, while the power squeezer and the split-pattern machine were completing their development, the much neglected jarring machine has grown steadily in favor and in size, until today there would seem to be no limit to its capacity. These machines are simple in construction and effective in operation, while on large work the saving to be effected by their use probably exceeds that by all other types of molding machines combined. I say on large work, because on small work jarring machines cannot compete with power squeezers of the same capacity, except perhaps in a few special cases where the work is deep.

Value of Labor Saving Appliances.

The value of any machine depends of course on what it can save, and what it costs to effect that saving; a problem to be worked out in every instance by a systematic time study of all the operations embodied in producing a given result. For instance, if it takes two men eight hours to mold by hand a certain pattern, in a flask 45 x 60 x 36 inches, and if five hours of this time is consumed in ramming sand, a jarring machine would save practically five hours of the time. It would not save any of the pattern-drawing and finishing time, nor any of the time for setting cores, but it would enable two men to make the mold in three hours, instead of in eight hours by hand. Hence, with a suitable jarring machine, two men could put up 2.67 times as much work as by hand.

In this case the jarring machine saves more than half of the molding time, and is therefore the most important help in the reduction of cost; but when patterns are rapped with a sledge, and drawn with a crane or hoist, a great deal of the molder's time may be taken up in finishing, or, to put it more bluntly, in repairing the damage done to the mold by this brutal way of rapping and drawing the pattern. Assuming that about one hour might be spent in finishing each half-mold when made by hand, an effective pattern-drawing machine could easily save two hours; and it is evident that with such a machine, two men could make a mold in six hours, thus increasing their rate of molding 1.33 times that by hand. By means of a sand conveyor, or even a clam-shell bucket on a traveling crane, perhaps 30 minutes could be saved, thus enabling two men to make the mold in 7½ hours. With this device only, they could make their rate of molding 1.067 times as fast as by hand.

Effect of Co-operation.

For the purpose of illustrating the effect of co-operation or concentrated effort upon any given piece of work, let us assume that the demand for the castings above referred to has resulted in the making of three sets of patterns, and that we have three sets of men at work making three molds a day by hand. Now, suppose we give one set of men a jarring machine, another set a pattern-drawing machine, and the third set a sand conveyor. In eight hours, the first set of men will produce 2.67 molds; the second set of men will produce 1.33 molds; the third set of men will produce 1.067 molds. Six men with three patterns will produce 5.067 molds, instead of three molds by hand, or about 1.7 times as much work.

On the other hand, if we have but one pattern and one set of men, and give them the combined help of a jarring machine, a pattern-drawing machine and a sand conveyor, two men will save 5 hours in ramming time, 2 hours in finishing time, and half an hour in shoveling sand, or 7½ hours in all; bringing the time on one mold down from 8 hours to 30 minutes, and increasing the production 16 times. In other words, the same assistance concentrated for the benefit of two men will result in more than three times the production, at less than one-ninth the cost per mold.

The above illustration shows, not only the advantage of concentrated effort in the use of labor saving appliances, but also the wide difference in results that may be realized from the same appliances in different hands. Not only does the concentrated effort in this case save the wages of four men and produce three times as much work, but it also distributes all of the indirect charges, which must ultimately be carried by the product, over a larger output. So much for the savings to be effected.

On the other hand, the interest on the investment, the depreciation of the machine and the consumption of power, must be accounted for; and in addition to all these, the damage that may be caused by the action of the jarring machine upon finished molds, or even upon buildings in the neighborhood, and the annoyance caused by noise and ground waves generally. This damage and annoyance has increased steadily with the increase in the size of the machines and in the weight of the loaded table. To meet these serious objections, various expedients have been adopted, among which may be mentioned a reduction in the stroke or drop, and a more or less resilient bedding for the anvil.

Principles Governing the Design of a Jarring Machine.

In the first place, it must be admitted, that although the packing of sand by the jarring process is very quick and effective in producing results, it is not very efficient under the most favorable conditions, as far as the expenditure of power is concerned, and that under certain conditions the efficiency may be reduced to zero. In the process of ramming, the density of sand is increased 25 or 30 per cent, and if a steam indicator were attached to the cylinder of a power squeezer, it may be questioned whether it would ever show over 1,000-foot pounds per cubic foot as the work actually done on the sand in squeezing it to proper density. Of course a great deal more power than this would be consumed in the use of water or air as a working fluid, but

[1] Transactions American Society of Mechanical Engineers, Vol. 13, p. 537.

the work put into the sand would in all probability not exceed 1,000-foot pounds per cubic foot.

To produce the same effect by jarring, the sand might be raised to a height of 4 inches and dropped upon an anvil 30 times; but to the weight of the sand must be added the weight of the table and flask, and the excess sand used as an aid in ramming. The first blow struck will cause the greatest flow of sand and will do the most work upon it, while each succeeding blow will increase the density and do less and less work, until, after a certain number of blows, the sand will remain at a density corresponding to the drop. When this point has been reached, the continued action of the jarring machine simply wastes power and produces no effect. The jarring machine is therefore more efficient during the earlier stages of the process than it can be when the condition of maximum density is approached; and for this reason, the longer the stroke the greater will be the efficiency. Other considerations of a practical nature, affecting the elasticity or durability of flasks and patterns and of the machine itself necessarily tend to limit the stroke, however, so that in practice it varies from ⅜ inch on some machines to 4 inches or more on others, with an average of perhaps 2½ inches.

In such machines, the most important consideration is solidity of construction and freedom from vibration of the jarring table. Otherwise the sand will become broken or laminated and the mold will be liable to fall apart in handling. Although lightness of construction in the jarring table is obviously desirable from the standpoint of economy in power, it is certainly not desirable from the standpoint of making perfect molds. The good results which accompany the stronger and stiffer table really cost less and consume less power in the end, because there are no failures necessitating repetition, or molds to be thrown away. The importance of solidity in the jarring table will be appreciated after a consideration of the character of rammed sand. It has a certain amount of elasticity, a good deal of resistance to further compression, and some tensile strength which of course is easily overcome. There must, therefore, be no movement between the pattern, sand and flask, tending to pull the sand apart, and of sufficient amplitude to cause fracture, and no lateral movement tending to slide one layer of sand over another. Such fracture or lamination may be caused by badly fitted pattern boards, flimsy patterns, or crooked flasks not properly bedded, but a light and flimsy jarring table that can be easily warped out of shape will augment the difficulty, and effectually prevent the success of good patterns carefully mounted in strong and firmly bedded flasks.

Design of the Table.

In the shockless jarring molding machine, the table adopted has been formed in one piece with the jarring cylinder. This table has great depth of beam, and the metal is distributed as it should be for economy of cast iron, in a broad expanse of plate on the tension side, and a smaller mass around the cylinder on the compression side, where the blow is struck. Radial ribs connect the tension and compression sides of the beam, forming a table of enormous strength and stiffness to distribute the central blow of impact equally in all directions. A table of this type is really stiffer than some of the anvils on which other tables are made to drop. At any rate, there is no perceptible vibration of the table when it strikes its anvil, or rather the buffer ring of leather, or other non-resilient material, interposed to relieve the sharpness of the blow and to reduce the noise. This buffer also helps to reduce vibration and rebound, by reducing the intensity of the force of impact. It is not, however, the rebound of the table from its anvil that injures a mold, so much as the rebound of the flask and sand from the table. Solidity of contact between table, pattern board and flask, is one of the most important elements for the successful working of a jarring machine; yet this detail rarely receives the attention it deserves, and not infrequently the machine is condemned for this reason, which is no fault of its own.

As already stated, unlimited power may be expended in jarring sand to any given density; and since there is a certain maximum density corresponding to any given drop, it is also quite evident that efficiency increases with the drop, and decreases with the dead weight handled over and above the weight of sand used. But a certain amount of dead weight is inseparable from the process, and for this reason a heavy machine may not be used to its best advantage on light work. Nevertheless, with air as a working fluid the benefit gained by expansion on light work offsets to a great extent the loss from the greater proportion of dead weight carried, giving to the jarring machine, which uses air expansively in its cylinder, quite a wide range of capacities, under approximately uniform efficiency as far as the consumption of air per cubic foot of sand rammed is concerned.

But it is not only the air consumed in lifting the loaded table that may not be utilized to the best advantage. At the instant when the loaded table strikes its anvil, the sudden change in the velocity of the table, whatever that may be, measures the pressure of impact, and the ramming effect is measured by the square of that change in velocity, which is proportional to the energy absorbed, part of which is utilized in ramming sand. Therefore, the greater the change in velocity at the instant of impact the greater the ramming effect, and by the laws of impact, the heavier the anvil the better. Efficiency in a plain jarring machine naturally increases with the weight put into the anvil; but since the cost of the machine depends very largely upon the weight of cast iron or concrete used, the weight of the anvil is generally limited to that of the loaded table. When the anvil is bedded on rock, it becomes practically of infinite weight, and capable of developing the maximum ramming effect for any drop given to the table. A rock bottom does not, however, eliminate the destructive ground waves, and often facilitates their transmission to unusual distances. To mitigate the effect of these shocks, the practice has been to bed the anvil on a timber cribbing, after the manner employed for steam hammers.

So cushioned, the anvil when struck by a loaded table of its own weight will suddenly acquire one-half of the velocity of the table at the instant of impact, after which both table and anvil will be brought to rest by the yielding resistance of the timber cribbing; they will then be returned by its elasticity to their normal position. The loaded table, in this case, loses at the instant of impact only one-half of the velocity it would lose by falling upon an anvil of infinite weight, as exemplified practically in an anvil founded on rock. As a result, the retardation of the table by the compression of the wooden cribbing is less intense and less effective in ramming sand, although this second change in velocity no doubt has some effect, especially in the earlier stages of the ramming process while the sand is comparatively soft. Nevertheless, the initial change in velocity, between a loaded table and a floating anvil of equal weight, is only half as great as the change in velocity of a loaded table falling the same distance upon an anvil of infinite weight; and the ramming effect in the

first instance, being measured by the square of the change in velocity, is only one-quarter as much as in the second case, where the whole energy in the falling mass is immediately absorbed.

Description of the Shockless Jarring Machine.

The shockless jarring machine consists, in its usual form, of a jarring table mounted upon an upstanding plunger forming the anvil, which in turn is mounted in a cylinder base and supported upon long helical steel springs. Compressed air, as the working fluid, is admitted through an automatic valve, under hand control, attached to the plunger or anvil base, and passes first into the jarring cylinder to raise the loaded table. At some predetermined point in the table movement, the air is automatically cut off from the cylinder, and while the valve is reversing, the confined air will expand and lift the table further from its anvil, provided its initial pressure exceeds the balancing pressure due to the weight carried. Then, when the operating valve completes its reverse movement, the air from the jarring cylinder may be exhausted into the atmosphere, but preferably it passes from the jarring cylinder to the anvil cylinder beneath and the table drops by gravity against the reduced pressure in its cylinder. At the same time, the plunger base or anvil is relieved of a considerable part of the load carried by its supporting springs, which immediately expand, giving the anvil an upward velocity to meet the falling table. When air is expanded from the jarring cylinder into the anvil cylinder, this upward velocity of the anvil is augmented and the falling velocity of the table is somewhat retarded, but in any case the momentum of the rising anvil is substantially equal to that of the falling table at the instant of impact. As a result, both table and anvil come to rest with great jarring or ramming effect upon the sand, but without shock or jar upon the foundation or any surrounding material.

When the air from the jarring cylinder is discharged at once into the atmosphere the momentum of the falling table may somewhat exceed that of the rising anvil at the instant of impact; but when this air is expanded into the anvil cylinder it compensates more or less for the loss of spring pressure as the anvil rises, and in this case the momentum of the rising anvil may exceed that of the falling table at the instant of impact. The difference, however, need not be very pronounced, and simply results in a slight initial velocity of the table and anvil at the beginning of the next stroke.

Advantage of Second Expansion.

The advantage of the second expansion is two-fold: it utilizes the potential energy of the compressed air in augmenting the momentum of the anvil, and at the same time it checks the acceleration of the table due to gravity and holds it in contact with the load upon it while falling. Otherwise a poorly fitted pattern board or flask may tend to spring away from its support while falling and cause lost motion, productive of a bad mold. For the same purpose, when the air is discharged directly from the jarring cylinder, a long compression spring between the jarring cylinder and its plunger may be introduced with good effect. In several instances such springs have been made to carry half the weight of the table with 8-inch compression. They assist in lifting the loaded table, and retard its acceleration in falling; and by their use the lifting capacity of jarring tables may be considerably augmented. Their chief purpose, however, is to retard the falling table and hold the pattern flask and sand firmly against it in readiness for the coming blow. With such a spring, the action of the table is, of course, somewhat slower in falling and more stroke is required to produce a given velocity of impact. On the other hand, the table rises faster and runs further to produce a given blow, and the increased stroke reduces the percentage of clearance space to plunger displacement. The spring in this position has, therefore, some beneficial effect upon the consumption of power, while serving a much better purpose, in the production of good molds, and, although not so important when the air from the jarring cylinder passes through the anvil cylinder, it may be of some value in that case also.

The valve mechanism, and the means by which it is controlled, do not particularly concern the present discussion. It will suffice to say that the machine is started and stopped by an operating lever which controls the admission of air to the automatic mechanism. So long as this lever is held down, the machine will run automatically, and when released, the machine will stop. A latched lever is arranged to adjust the stroke, which can be varied while the machine is running. A safety stop is also provided to limit the table movement through the action of the main valve attached to the plunger base. When pressure is admitted to the jarring cylinder, the anvil cylinder opens to exhaust. When in action, it descends while the table is rising and then rises to meet the falling table.

Machine For 25-Ton Molds.

A machine is now being built for a large foundry to handle half molds weighing 25 tons. The table is a steel casting 8 x 12 feet, with lifting cylinder, 3 feet in diameter, and the plunger base forming the anvil is a solid iron casting weighing 65,000 pounds. This is carried upon 22 steel springs, designed to compress 8 inches under the maximum load and to develop a working stress of only 60,000 pounds per square inch, which is very much less than the usual working stresses on railway car springs and quite within safe limits. The total weight of the machine complete will probably be in excess of 90,000 pounds. This is carried in a concrete pit designed simply to protect the machine and to support the static load on the floor of the pit.

Attention should also be called to the possibility of installing a machine of the shockless type on the upper floors of high buildings, where many foundries are now being located. The action of the machine is entirely free from jar except where it is wanted, on the work produced, and the pulsating variation in floor load while running is no greater than is usually experienced in the operation of power squeezers. A number of these machines are now under construction for installation on upper floors, and in this connection it may be of interest to note that the original experimental machine was set up on floor beams over a pit and operated without any vibration appreciable to a man standing on the beams while ramming up a half mold weighing about 1,000 pounds. In this case the weight of the machine was about 6,000 pounds, and a stroke of 4 inches was employed. As the movement of the anvil was about 1 inch, it met the table when it had fallen about 3 inches. The variation in the load in the floor beams was about 10 per cent of the static load carried, or between 600 and 700 pounds. This variation, however, was gradual, the anvil rising and falling with the movement of the table. When impact occurred, the load on the floor beams simply ceased to decrease, and began again to increase without transmitting to the floor beams any part of the shock of impact, which was confined exclusively to the jarring table and its plunger base.

MOLDING CIRCULAR SEGMENT PLATES

How these castings were produced in a gray iron jobbing foundry --- Details of the construction of the pattern

By G. BUCHANAN

THE gray iron jobbing foundry is called upon to make tank plates in a great variety of forms, and the tonnage in many shops is considerable in the course of a year. The methods employed in the production of these tank sections are as numerous and differ as widely as do the tanks themselves. Although a few foundries make a specialty of this line of work, the trade is by no means confined to these shops, for in the general machinery foundry the tank plate is quite a regular feature.

With very few exceptions, the tank plate is a repetition job, and makeshift methods, both in patternmaking and molding, are to be avoided. It is not uncommon to have 100 or more plates to make from a single pattern without alterations, and these are used for a single tank. In many instances, one pattern only is necessary with alterations to complete all the plates for a tank. Purchasers of these tanks, as a rule, are willing to permit variations within the limits of the dimensions of their tanks, as long as the capacity is retained. Thus a considerable saving in expense can be effected both in the patterns and in the molding, and concessions have, in many cases, only to be asked for when quoting for the work, to be granted. A slightly reduced price for such concessions will generally secure the order.

Tanks may be divided into two classes, rectangular and circular. A method of making circular segment plates, which gives very satisfactory results, will be described. A number of segment plates is shown in Fig. 1. It will be noted that the flanges are external and that there is a bracket between each bolt hole. A facing strip extends along the outer edges of the flanges. These plates, when bolted together, form a circular mixing tower used by paper makers. In this instance the number of plates required in the circle is eight. Each plate weighs 500 pounds, and the inside diameter of the tank is 9 feet, while the depth of these towers is 26 feet, consisting of five tiers of circular segments and one tier of conical plates. These plates are not machined on the facing strips, but are used direct from the foundry and can be fitted together with very little labor. In fact, in erecting 10 complete towers only two plates were rejected. These plates are made in green sand and the castings must be clean and smooth. Scabs or veins of any kind are not permitted, as it is essential that the insides of these tanks must have a smooth surface. All joints are filled in from the inside with cement mixed to the consistency of putty, and rammed into the joints, which are ½ inch wide.

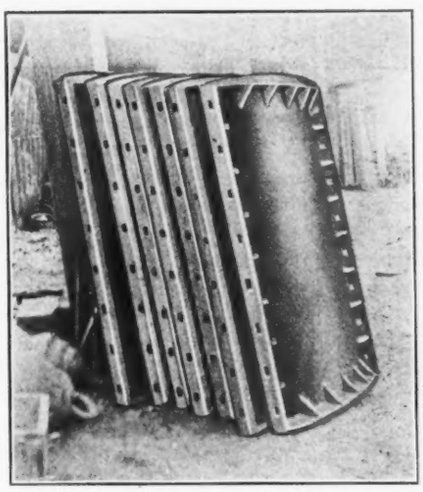


FIG. 1—A NUMBER OF SEGMENT PLATES FOR A LARGE CAST IRON TANK

Pattern for Segment Plates.

The pattern for the circular segments is first made of wood, from which a metal pattern is obtained. The outside strips, which also form the width of the facings, are made loose. Some leeway is permitted in the shape of the bolt holes in the radial flange, as shown at *A A*, Fig. 4. This generally is not objected to, and is necessary as it insures a clean delivery of the pattern from the mold. As the number of plates generally required from a pattern is considerable, a plate pattern is made for this piece, the loose strips being cast separately in brass. The plate pattern is made by the addition of about 6 inches of joint attached to the wood pattern. The back of the mold is formed on another plate. This is necessary as the end of the circular strips are extended and come out through the back of the pattern plate. The conical pattern is made in a similar manner,

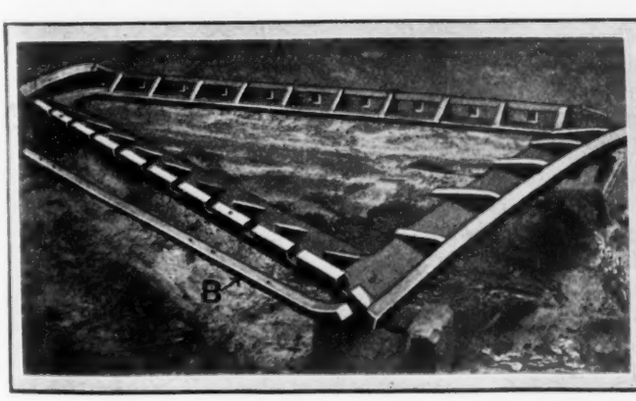


FIG. 2—SKELETON PATTERN FOR CONICAL CAST IRON TANK PLATE

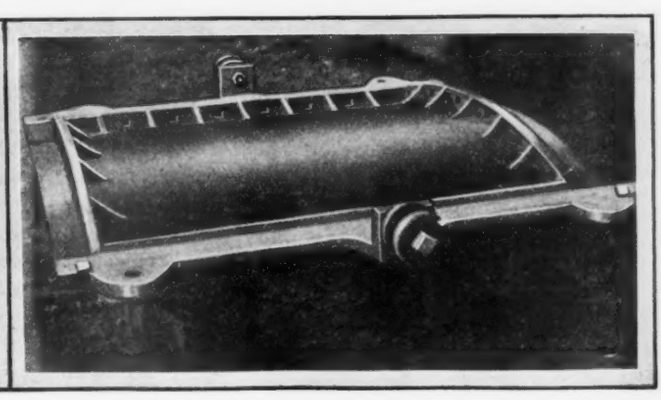


FIG. 3—PATTERN PLATE FOR CIRCULAR SEGMENT TANK PLATE

but is a framed pattern only, as the number required does not warrant the expense of a plate pattern. This is shown in Fig. 2. One of the strips is shown at *B* at the side of its flange, plate. The flanges have their strips set ready for use.

When making a circular segment, the plate pattern is covered with facing sand, and some of this sand is tucked into the flange openings. The radial flanges require no support. The drag half of the mold is lowered on the plate and the mold is rammed in the usual manner. After venting the drag, the flask is lifted on its trunnions, is rolled over and is set on a suitable bed on the floor. The plate pattern is then given a few blows with a wood mallet, and the two strips, *D D*, Fig. 6, are drawn out. The plate pattern is then withdrawn, is rolled over and is set on the floor in position for another mold. A view of the mold at this stage of its construction is shown in Fig. 7. The side strips *E E* are drawn out, leaving the mold ready for the cope. This is formed by a separate plate, a sectional view of which, together with its flask, is shown in Fig. 5. In ordinary practice, after drawing the plate pattern, the various cores would have to be set in each flange, and a certain amount of finishing would have to be done. A casting with the use of dry sand cores will not compare favorably with the one obtained from a mold made with green sand cores, which will not contain a single core print mark, and will require no finishing whatever.

The conical tank plate is made by being bedded in a drag flask as shown in Fig. 8. In this view the drag half of the mold is shown ready for the cope. After the top has been lifted off, the strips are drawn and the pattern lifted out, the mold requiring very little finishing before it is ready for finally closing over the cope. The screws, shown in Fig. 8, keep the strips in position while bedding-in. After the joint is formed, the screws are taken out. Very little cleaning is required on plates made in this way. A metal straight edge is tried against all straight flange strips, the result being a set of plates which will fit together with very little labor, and on which the labor cost for molding and cleaning will only amount to about $4.00 per ton.

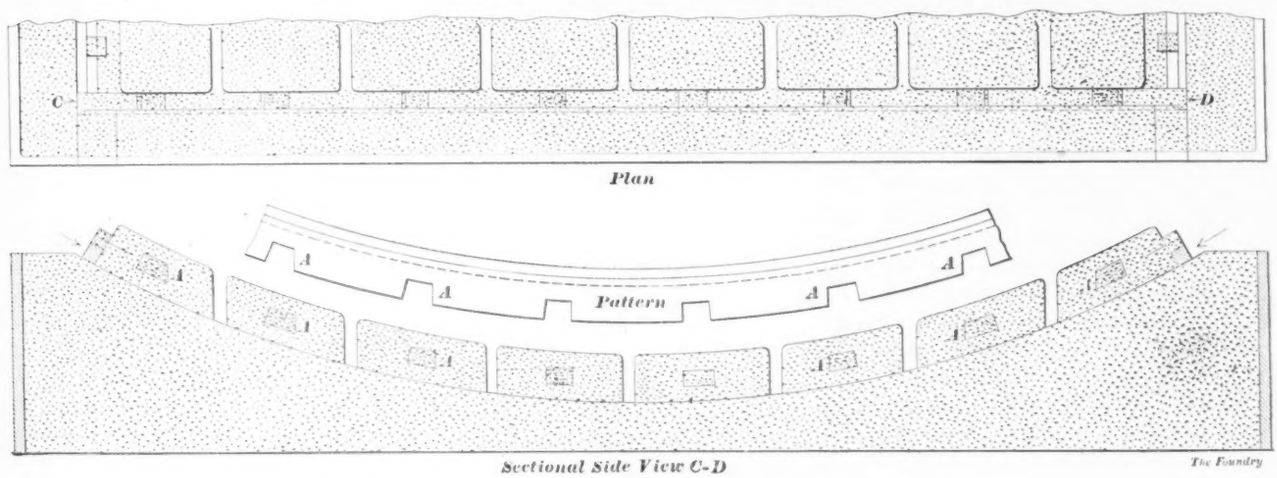


FIG. 4—PLAN AND SECTIONAL VIEW OF TANK PLATE PATTERN

and the others are fixed in their respective positions by means of screws. The inside of the frame pattern is formed by means of the pattern and strickles. A loose plate is made in this way, which fits easily into the opening in the frame pattern. The wood patterns are tried carefully, two contractions being allowed. As there are no core prints, but the core slots themselves, not nearly so much filing is required on the metal patterns as would be the case if core prints were cast on the same. Fig. 3 is a view of the plate pattern used for the circular segment

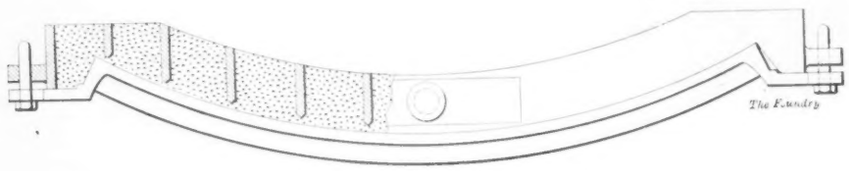


FIG. 5—SECTIONAL VIEW OF COPE HALF OF TANK PLATE MOLD

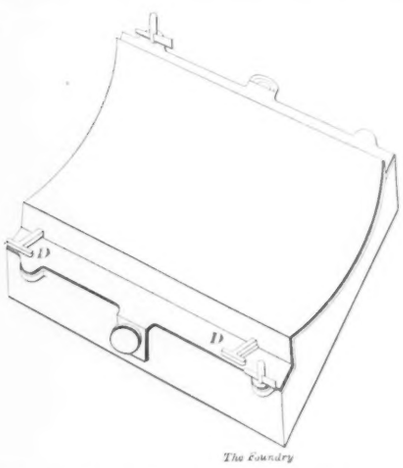


FIG. 6—DRAG HALF OF MOLD, SHOWING BACK OF PLATE

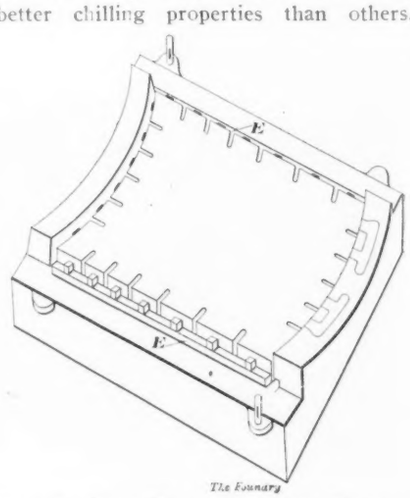


FIG. 7—DRAG HALF OF MOLD SHOWING SIDE STRIPS

GRAY IRON FOR PLOW POINTS.

BY W. J. KEEP

Question:—We would like to have the proper analysis for moldboards and plow point castings. We have had some trouble with our coke, inasmuch as it has been high in sulphur.

Answer:—The chill is largely a question of analysis, but some irons have better chilling properties than others.

It requires considerable skill to obtain a hard wearing surface on plow points and still retain the gray iron backing for strength. The sulphur in your coke increases the chill and therefore you should increase the silicon sufficiently to counteract this effect to a limited extent. You should also increase the manganese up to 1 per cent at least, and this can be accomplished by adding ferro-manganese in the ladle. As the silicon must be varied to give the desired chill under the varying conditions of each of these operations, it is advisable to make a frequent chill test and to vary the mixture accordingly. The best plow work that I ever saw was made in a foundry where one cupola was melting a chilling mixture and another cupola melted a soft stove plate iron. The chilling mixture was made low in silicon, and when the ladle was filled, a chill test was quickly made and sufficient soft iron was added to increase the chill to the desired depth.

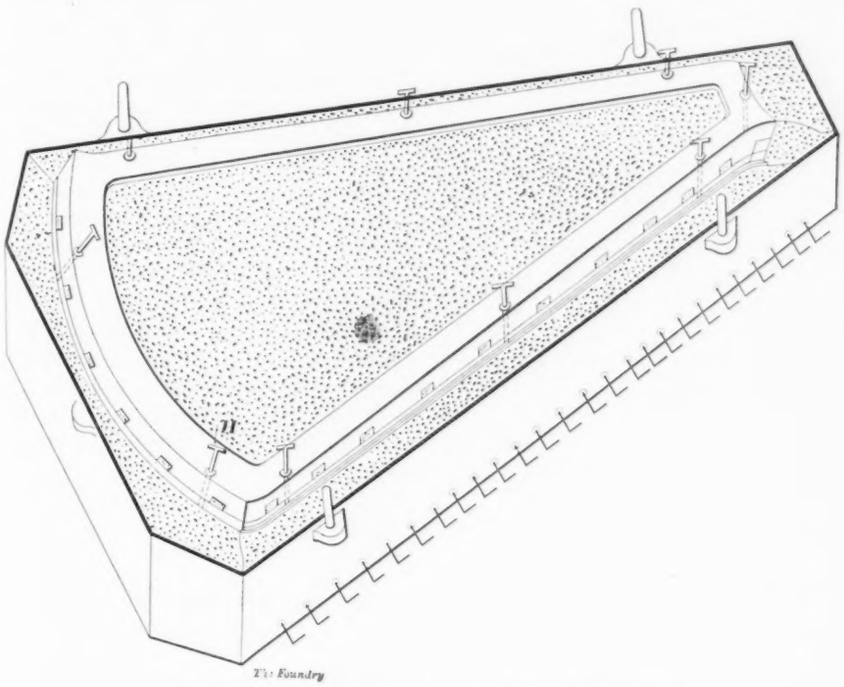


FIG. 8—DRAG HALF OF CONICAL TANK PLATE MOLD

CASTING A TABLET.

By W. J. KEEP

Question:—I have taken a job of casting a tablet but the letters are made with very little draft and the small cores are loose when the pattern is drawn. Can you suggest a way of overcoming this difficulty?

Answer:—Move the cores in place and sift powdered rosin all over the lettered surface of the sand. Heat an iron plate and hold it near the letters until all of the rosin is melted. This will hold the letters, and if you vent the drag thoroughly you will be able to produce a good sound casting.

Some Unique Foundry Experiences

By P. DWYER

WHILE willing to admit that the following description of some molding difficulties would hardly be regarded as sufficient evidence on which to base a claim for the Noble prize for distinguished scientific discovery, or the Carnegie medal for heroism in the face of danger, and while it is extremely improbable that exactly similar conditions will occur again, still, I know from experience—and so, I suppose, do you—that the solving of one problem frequently suggests the key for others, some of them of an entirely different character. It is with this object in view that I am tempted to record a few unique experiences, which at one time or another came under my observation.

Problems of the Jobbing Shop.

With all due respect to the foundrymen, who specialize some or all of their work, and admitting that it is the better way when conditions warrant, still the great majority of shops cannot secure these favorable conditions and have to take anything that comes along, provided it is within their capacity and there seems a chance to turn an honest dollar. It is in such shops that the foundryman's inventive faculty is brought into play, when he is forced to adapt himself to existing conditions; and among all the foundries where such conditions obtain, commend me to those operated in conjunction with, and part of, iron and steel producing plants.

Steel Works' Foundries.

Not only have the castings to be made at a minimum cost, but what is often of more importance, in the shortest possible time. This happy combination of circumstances generally has the effect of preventing the foundryman from spending over-much time sitting on a nail keg, looking wise, or discussing with his friend, the patternmaker, the live political issues of the day, as was the custom of foundrymen of repute when we were a boy.

Agility of the Molder.

In common with other men who have spent many years at the trade, I could recite numerous instances of this peculiar faculty which the molder has of getting out of a hole. Perhaps the fact that most of his time is spent in getting into and out of holes of various shapes and sizes may account for his agility in this respect, but I will confine myself to one or two instances. An order was received from the blast furnace department for two cinder pots. These castings are shaped like an old-fashioned, round bottom, farmer's boiler. They are 10 feet across the top and 8 feet deep, 5 inches thick at the bottom, gradually tapering off to 2 inches at the top. They are further re-inforced with two bands, one around the top, and the other 30 inches down the outside, the latter also serving to hold the ladle in its carriage when in use. These two bands were connected by a series of 14 perpendicular ribs, 2½ inches thick and 4 inches wide. Four of these ribs were double and held splitting cores, which, after the pot was cast, were replaced by suitable pieces of ⅛-inch boiler plate, with a round hole near the top of each. These holes were for the purpose of lifting the pot into and out of its carriage.

A hole, 12 feet square by 10 feet deep, was dug and four binders, 11

feet long by 8 inches square, with slots in each end to receive 2-inch bolts, 12 feet long, were laid across the bottom. The ground being very wet, coke was filled in between the binders, and a barrel, served by a steam siphon, sunk at one end of the pit. This was calculated to get rid of any water that might accumulate. Plates were laid on top of the binders, a spindle seat and spindle set, and the outside of the pot swept up in loam and the hole rammed up solid. The mold was dried with a coke basket. The core was built up on a plate, dried in the oven, turned over and the mold closed. Binders similar to those on the bottom were placed across the top and screwed down by the long bolts previously mentioned.

When the Mold Backed.

These two pots were satisfactorily cast, the outside part of the mold from the ribs down, of course stripping clean and being as good as when first made. The pit then remained idle for a couple of months, when an order was received for two more pots. By this time, notwithstanding the fact that the siphon had been used more or less regularly, the sand surrounding the brickwork had become very wet. A large coke fire was kept going for two days, then the top part of the mold was built up and the fire kept going for two days more. Then, as it looked fairly dry, the mold was closed and cast, but it coughed most distressingly while the medicine was being poured in. When the casting was partly stripped, it was found to be so scabby as to make it unfit for use. To dig the whole thing out would entail considerable expense and waste of time, besides making a repetition of the same trouble later on, so it was decided to leave the casting where it was, to act as a water tight casing, and build the other pots inside of it.

An Ill Wind, Etc.

The brickwork was stripped out, a coke bed put in the bottom, a spindle seat and spindle set, and a single wall built up inside the old casting, with a layer of fine coke between the brickwork and the casting. A retaining ring, 9 inches wide, was cast in open sand and laid on top of the brickwork, where it came flush with the top of the old casting. The lower band of the new pot was built on this and the rest of the mold built up, a jointed curbing laid around and rammed up, the only new rigging required being extensions for the holding down bolts. Then the foundryman smiled to himself and said, "I guess that will hold you for awhile." Six pots have been made there since with no trouble of any kind.

"Soft Solder" in a Steel Works' Foundry.

Another instance of this adaptability occurred in a small place, in one end of a building covering ten 50-ton open-hearth steel furnaces, which made steel for rail, billet and rod mills. This little spot, which covered an area of about 30 feet by 30 feet, was dignified by the name of "the steel foundry" and the molders certainly led a strenuous existence in maintaining this vast expanse of territory. They were regarded as interlopers, and everybody's hand was turned against them. During the day they kept the enemy at bay fairly well, but during the dark hours of the night these miscreants got in their fine work. It was nothing uncommon to find a cage off one of the furnaces, a pan of slag, or a 50-ton ladle reposing gracefully on the middle of the floor in the morning, and it required a considerable degree of diplomacy, or what Sam Slick called "soft solder," to get the cranemen to shift it out of the way.

"Getting Back" at the Cranemen.

A job came in one day which required a core about 6 feet long, 2 feet wide, and 1 foot thick, and the brilliant idea seized one of the molders that he could obviate a day's delay in getting an arbor made in the iron foundry and sent down, and incidentally "get back" at the cranemen. Taking advantage of a favorable opportunity, and aided and abetted by a trusty henchman armed with a sledge hammer and cutter, they very neatly removed a 6-foot length from the bottom end of an iron ladder which the cranemen used to climb up to their cage, and it made a beautiful core arbor. Of course, when the loss was discovered, the cranemen raised a row, and even made insinuations touching the honesty and morals of the molders, but they were too discreetly busy to notice such trifles.

Tempering the Wind, Etc.

This steel foundry was only a makeshift, and no pretense was ever made that it was equipped to handle work in regular foundry style. The furnaces all made steel for rolling purposes in the different mills, and the molders had to be constantly on the alert to get their castings poured. Nevertheless, by working a double shift, four men by day and two by night, they managed to get an average of 80 tons a month, in castings ranging from a few pounds to 15 tons, but it required some maneuvering. Even Divine Providence, which tempers the wind to the shorn lamb, seemed to give this place the go-by. In summer, with a south wind carrying the heat from over the furnaces towards the foundry, the atmosphere was almost choking, and in winter—well, I don't believe even Peary himself in his jaunt to the North Pole and back, ever endured worse. It was nothing out of the ordinary to hook the crane on a cope to lift it off and find the cope and drag frozen so solidly together that the drag would lift too, and it would take a crow bar to pinch them apart. Sand would freeze in a core box while it was being rammed, and the whole would have to be taken in the oven before the core could be removed.

I will never forget that foundry, for notwithstanding its many shortcomings, it demonstrated how well the molder can adapt himself to the most extraordinary conditions and produce castings under the most unique and difficult circumstances.

FOAMING SLAG.

By W. J. KEEP

Question:—Our cupola is lined to 36 inches and we melt from 6 to 6½ tons of iron per day. Occasionally we have considerable trouble with the last portion of our heat, as the slag boils up, runs through the tuyeres and fills the wind box when the blast is reduced. The slag is spongy and very light.

Answer:—The trouble is with the coke and the method of charging. The coke is too high in volatile matter, but this cannot be prevented when you use such a small quantity. However, you might suggest to the coke producer that he send you a grade of coke that is burnt harder. Have your cupola tender exercise care to avoid charging dirt. Have him use a fork for charging both coke and scrap and do not charge the sweepings until the very last of the heat. Break the scrap as small as the pig iron and charge uniformly. If the trouble continues, it might be advisable to tap out the slag soon after the iron comes down, and not to let it get nearer than 4 inches below the tuyeres. You are making so much slag that it rises around the tuyeres and the blast, therefore, raises it, sometimes, to the height of the charging door. When the blast is reduced the slag runs down and fills the lower part of the cupola.

SEGREGATION OF METALLOIDS IN STEEL

Further observations upon this phenomenon and the results of research work in the field of the silicon-iron compounds

By S. S. KNIGHT

SINCE the publication by the author of the results of his observations[1] upon the segregation of the various metalloids in steel, there has been some criticism as to the statements made by him in regard to silicon-iron compounds. As stated then, the silicon-iron compounds had not been isolated either metallographically or chemically, and I am not at all sure that the photo-micrographs which follow, really show silicon-iron compounds, although it is reasonable to assume that they do. The research work which the writer has done in the field of the silicon-iron compounds, has been unsatisfactory, but since the question has been brought up, it may be of interest to know that these have been the subject of a reasonable amount of research work, and the photo-micrographs which follow give the clearest idea of these compounds which is available at present, to the best of the writer's information.

Fig. 1 shows a sample of so-called silicon steel, the magnification being 48 diameters, the specimen being etched with nitric and hydrofluoric acids. The analysis of this specimen was as follows:

	Per cent
Silicon	5.73
Sulphur	0.010
Phosphorus	0.005
Manganese	None
Carbon	0.02
Copper	0.15

Fig. 2 shows a still higher magnification of this same specimen in the same field, the photo-micrograph showing 154 diameters magnification, and also showing plainly that the open patches do not become resolved under a higher magnification.

Fig. 3 shows another specimen with a magnification of 86 diameters, the analysis of which was as follows:

	Per cent
Silicon	1.55
Sulphur	0.007
Phosphorus	0.006
Manganese	None
Carbon	0.02
Copper	0.11

This sample was etched with picric acid.

Fig. 4 shows a very pure iron base, into which a small amount of silicon has been injected. The magnification in this case is 86 diameters, and the analysis is as follows:

	Per cent
Silicon	0.10
Sulphur	0.007
Phosphorus	0.006
Manganese	None
Carbon	0.02
Copper	0.11

This sample is etched with picric acid, and the characteristic pentagonal form of ferrite crystallization, with the edges and vertices of the crystals very plainly marked, are easily discernible. The influence of the silicon is shown in the dark patches, which naturally arrange themselves around the edges of the crystals.

Owing to the fact that satisfactory chemical re-agents have not been found to dissolve away all the material except that in which the iron base was combined with the silicon, the author is not able to even hazard a guess as to the chemical composition of the silicon-iron compounds. From his observations, he is inclined to believe that there is only one compound of silicon present in any material which he has investigated and if it were consistent with the facts as shown in the photo-micrograph, he would be inclined to believe that the solid solution theory applies well to the facts as we know them, with regard to the segregation of silicon in steel.

It may be of interest to know that in the matter of pure irons, the structure shown in samples as cast,[2] is usually very different from that shown

[1] THE FOUNDRY, April, 1910.

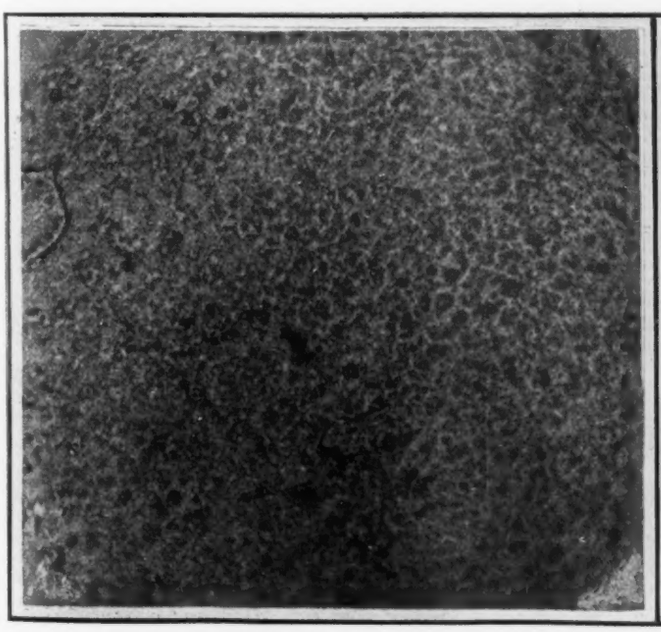


FIG. 1—SAMPLE OF SILICON STEEL
(Magnification 48 Diameters.)

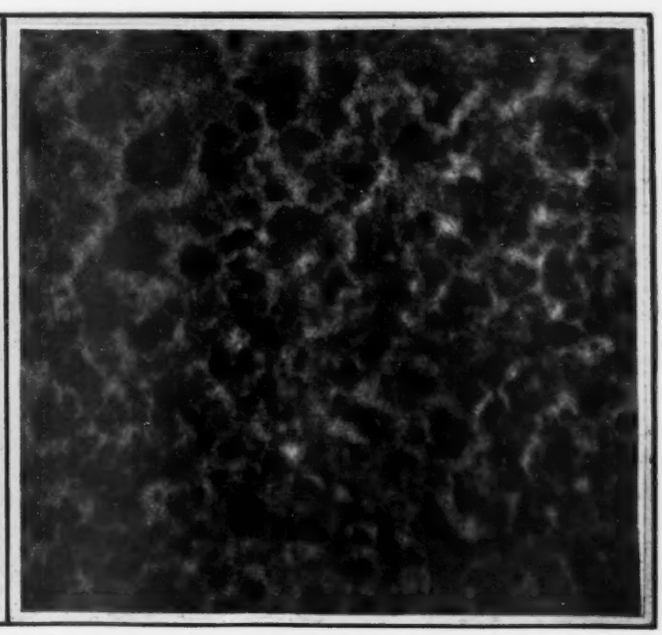


FIG. 2—SAMPLE OF SILICON STEEL
(Magnification 154 Diameters.)

FIG. 3—SAMPLE OF SILICON STEEL
(Magnification 86 Diameters.)

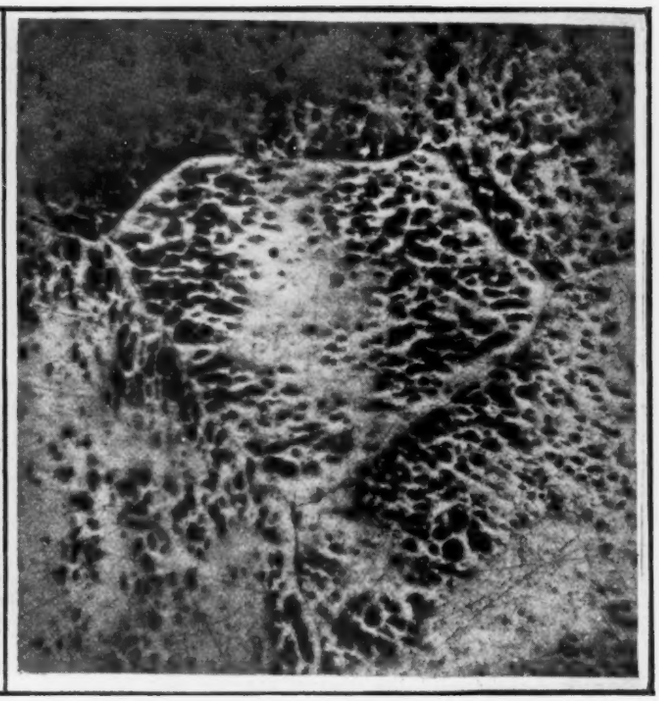


FIG. 4—PURE IRON, CONTAINING A SMALL AMOUNT OF SILICON
(Magnification 86 Diameters.)

in samples which have undergone work. As an illustration of this, Fig. 5 represents a material analysis as follows:

	Per cent
Silicon	0.02
Sulphur	0.006
Phosphorus	0.005
Manganese	None
Carbon	0.02
Copper	0.14

This sample was etched with picric acid, the magnification being 48 diameters. The same field is shown in Fig. 6, at a magnification of 154 diameters. In Fig. 7 we have a photo-micrograph of 154 diameters magnification, the material analyzing as follows:

	Per cent
Silicon	None
Sulphur	0.007
Phosphorus	0.006
Manganese	None
Carbon	0.02
Copper	0.14

This specimen was also etched with picric acid, and shows a characteristic pure iron base, upon which no work has been done.

The influence of small amounts of sulphur, phosphorus and manganese are shown in Fig 8, which was taken under a magnification of 154 diameters, the analysis being as follows:

	Per cent
Silicon	None
Sulphur	0.066
Phosphorus	0.034
Manganese	0.35
Carbon	0.02
Copper	None

This was also etched with picric acid. In order to obtain as pure an iron base as possible, the purest iron by hydrogen was melted in silica crucibles upon the breast of an open hearth furnace and Fig. 9 shows such a specimen just as cast, the magnification being 154 diameters, the etching re-agent being picric acid. This

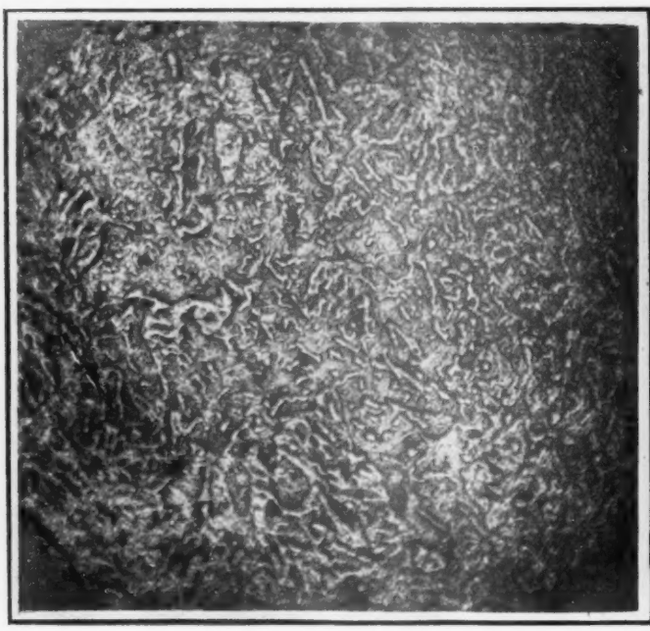


FIG. 5—PURE IRON AS CAST
(Magnification 48 Diameters.)

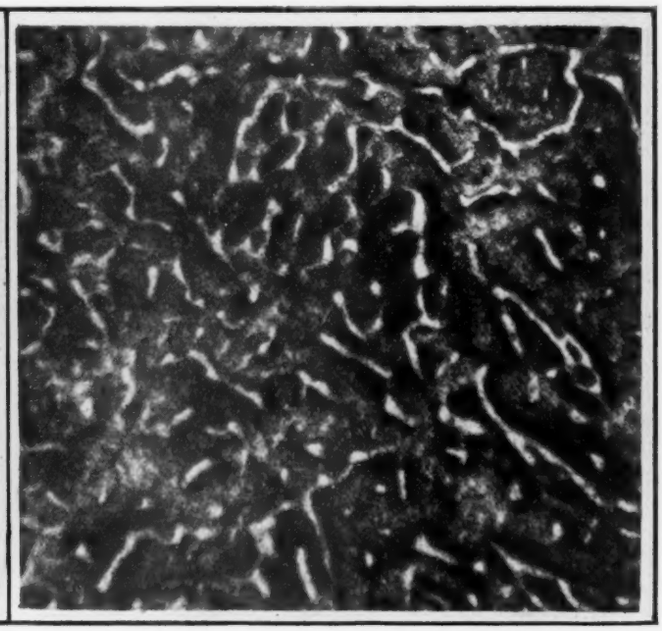


FIG. 6—SAME FIELD AS FIG. 5
(Magnification 154 Diameters.)

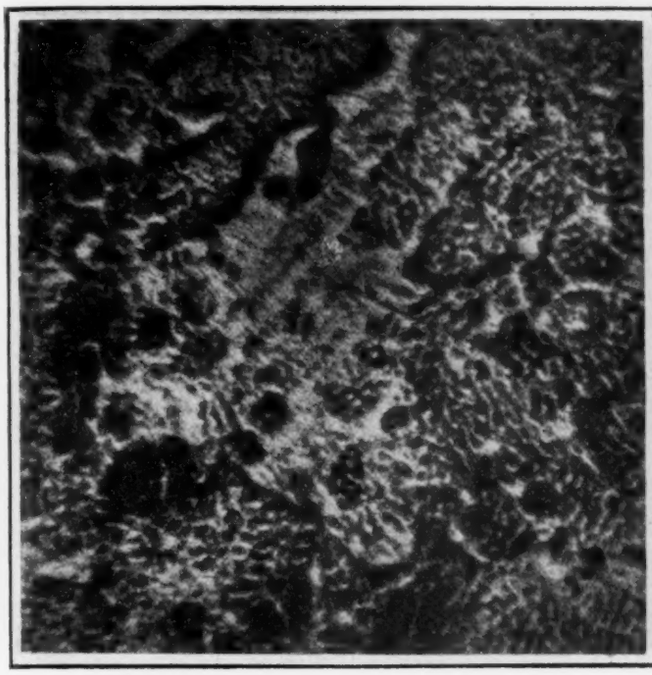


FIG. 7—PHOTO-MICROGRAPH OF SAMPLE HAVING A PURE IRON BASE
(Magnification 154 Diameters.)

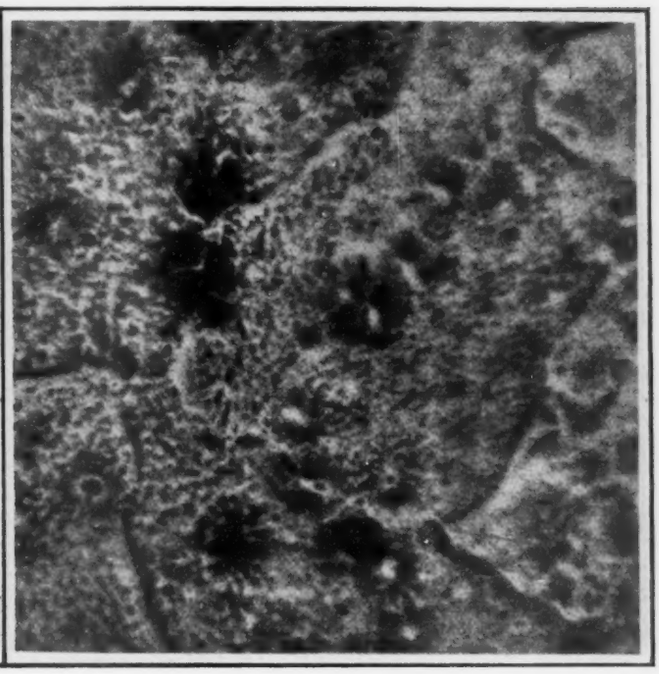


FIG. 8—INFLUENCE OF SMALL AMOUNTS OF SULPHUR, PHOSPHORUS AND MANGANESE
(Magnification 154 Diameters.)

material showed just a trace of sulphur and phosphorus, but of so slight an extent as not to be determinable by ordinary laboratory methods, while it was practically free from silicon, manganese, carbon and copper.

Fig. 10 shows another sample of the same material at 86 diameters magnification, the etching re-agent being picric acid.

It may be of interest to know that mechanically, the segregation of the various metalloids in steel, as far as the writer has been able to observe, nearly always takes place along certain well-defined lines. Fig. 11 shows a very typical method of segregation, the pentaganal form of crystallization being 154 diameters, and the etching re-agent being nitric acid. This button was taken from the center of segregation in the hot-poured 26-inch ingot previously described. The analysis at this particular point was as follows:

	Per cent
Silicon	0.45
Sulphur	0.147
Phosphorus	0.188
Manganese	0.91
Carbon	0.52
Copper	0.85

This type of segregation, which is analogous in form to the concretions found in petrographic geology, would lead us to believe that segregation takes place in steel in much the same was as concretions are formed in mud beds. It is the writer's belief that a sulphide of iron or manganese is in nearly every instance the beginning of the segregated mass. In this par-

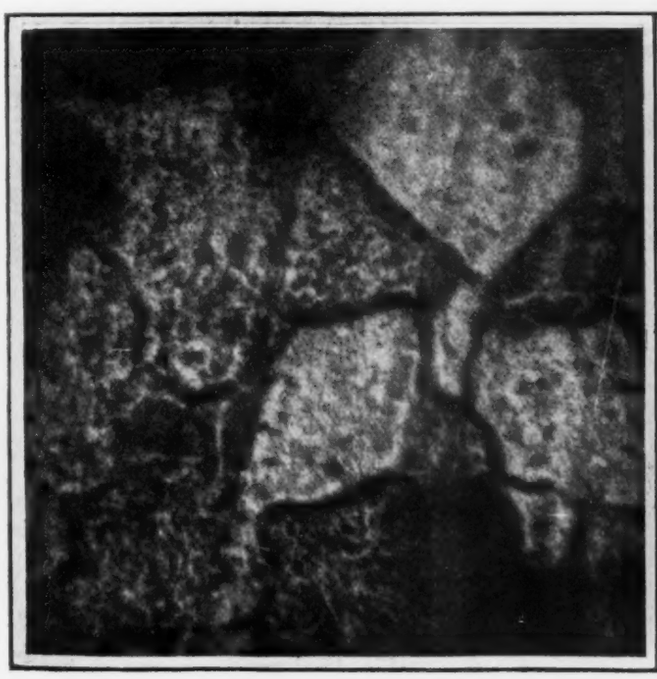


FIG. 9—SPECIMEN WITH PURE IRON BASE, AS CAST
(Magnification 154 Diameters.)

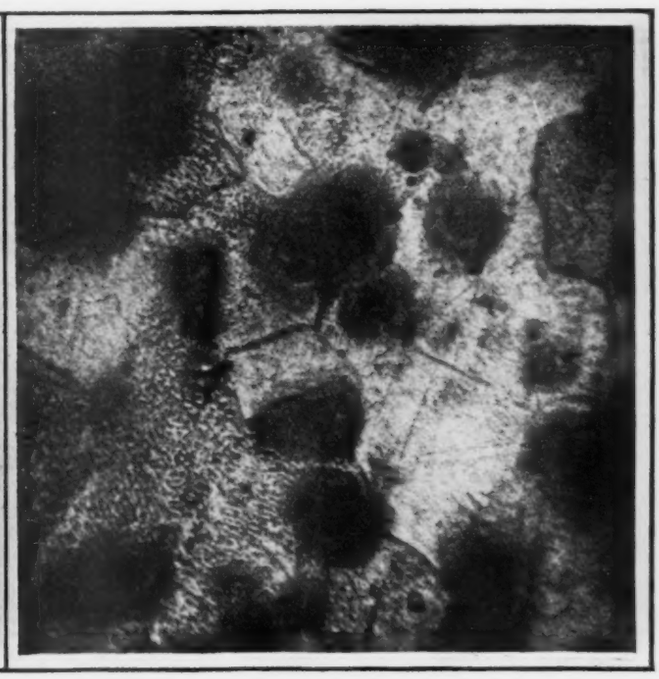


FIG. 10—AN ETCHED SAMPLE OF SAME MATERIAL AS FIG. 9
(Magnification 86 Diameters.)

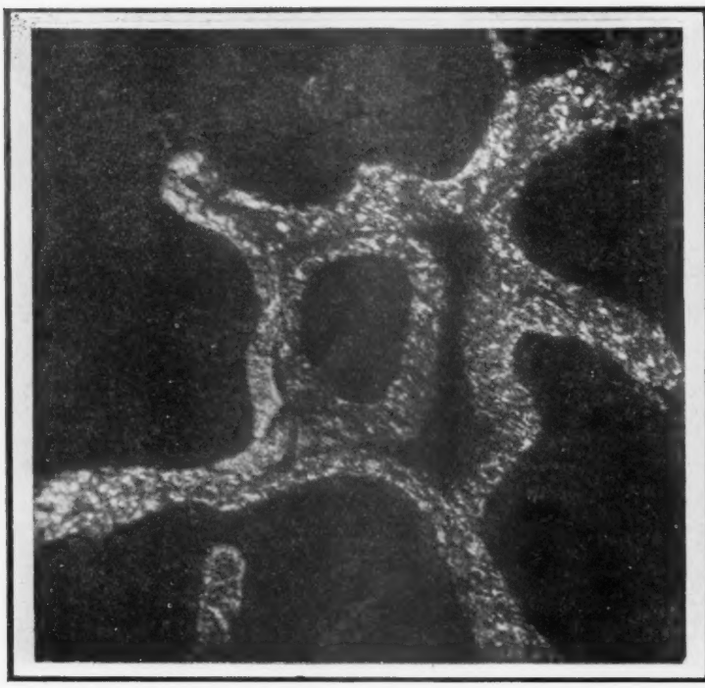


FIG. 11—TYPICAL SEGREGATION OF METALLOIDS IN STEEL
(Magnification 154 Diameters.)

FIG. 12—ANOTHER FIELD ON THE SPECIMEN SHOWN IN FIG. 11
(Magnification 154 Diameters.)

ticular specimen, it seems to be sulphide of manganese, around which we see a layer of sulphide of iron, and around which we find still another layer of sulphide of manganese, which in turn is surrounded by a layer of sulphides and phosphides of iron, which continue along the edges of the crystal to the vertices and on along the edges of the adjacent crystals.

Fig. 12 shows another field upon the same specimen, the magnification being 154 diameters; and here we are at a loss to know whether the small patches in the segregated sections are compounds of silicon or of manganese sulphide.

Fig. 13 shows still another field upon this same specimen, the magnification being 154 diameters, and here we believe the included mass to be manganese sulphide, while the segregated patch itself is iron sulphide, which in turn is surrounded by manganese sulphide, and it in turn by a layer of iron sulphides and phosphides.

Fig. 14 shows a field under a magnification of 154 diameters, at the point of maximum segregation in a small test ingot, which was split longitudinally, and the segregation in which was very carefully studied. The sample was etched with nitric acid, and the analysis at this particular point was as follows:

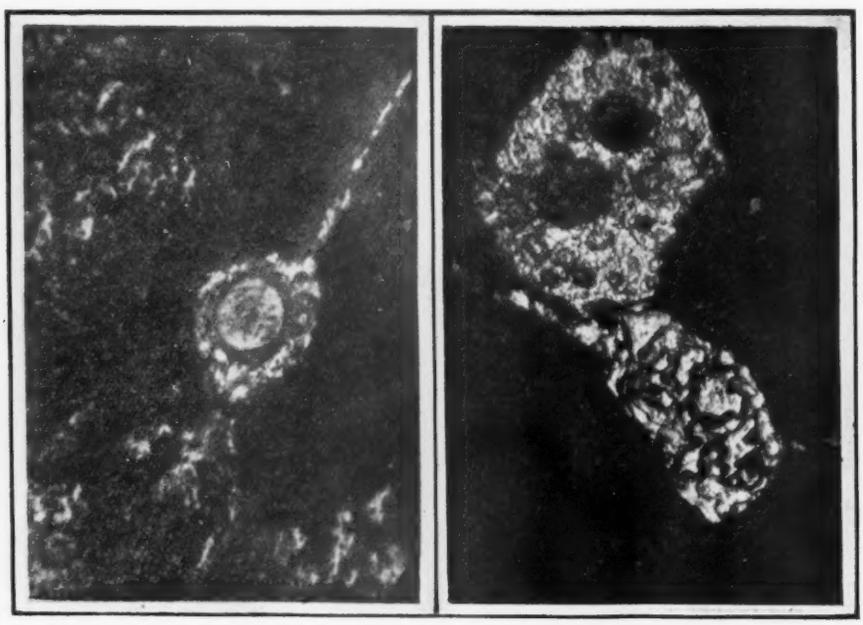
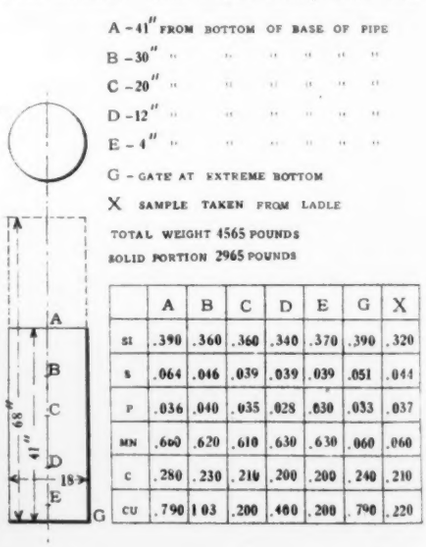


FIG. 13—ANOTHER FIELD ON SPECIMEN SHOWN IN FIG. 11
(Magnification 154 Diameters.)

FIG. 14—POINT OF MAXIMUM SEGREGATION IN A SMALL TEST INGOT
(Magnification 154 Diameters.)


A - 41" FROM BOTTOM OF BASE OF PIPE
B - 30" " " " " " "
C - 20" " " " " " "
D - 12" " " " " " "
E - 4" " " " " " "
G - GATE AT EXTREME BOTTOM
X SAMPLE TAKEN FROM LADLE
TOTAL WEIGHT 4565 POUNDS
SOLID PORTION 2965 POUNDS
68"
41"
18"

	A	B	C	D	E	G	X
SI	.390	.360	.360	.340	.370	.390	.320
S	.064	.046	.039	.039	.039	.051	.044
P	.036	.040	.035	.028	.030	.033	.037
MN	.600	.620	.610	.630	.630	.060	.060
C	.280	.230	.210	.200	.200	.240	.210
CU	.790	1.03	.200	.460	.200	.790	.220

FIG. 15—SEGREGATION CHART OF A TEST INGOT

	Per cent
Silicon	0.39
Sulphur	0.064
Phosphorus	0.036
Manganese	0.66
Carbon	0.28
Copper	0.79

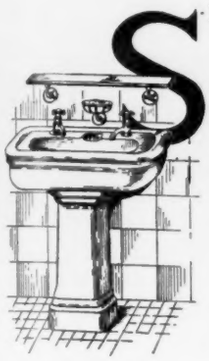
This segregation body is quite characteristic, and is very frequently seen by metallographical investigators, and the sulphides of manganese and iron and phosphides of iron are quite clearly shown.

Fig. 15 shows a segregation chart of this test ingot, and the analyses may be of interest.

ENAMELED CAST IRON SANITARY WARE

Arrangement of the enameling room and a description of the cooling ovens --- Method of crating tubs and lavatories

By DILLEN UNDERHILL



SECTIONAL and front elevations of the tub enameling room are shown in Figs. 1 and 2. The enameling room for small ware is similar to this, but the enameling furnace is not so long and no cooling room is provided for the enameled ware. In Fig. 1, it will be noted, that a heavy brick wall separates the furnaces from the enameling room. This is done to protect the enameler from the excessive heat of the furnaces. The enameler, to protect himself from the heat of the tub, is heavily clothed, and to protect one hand and arm he uses a large quilted sack. His face is protected with a section of tin plate having holes cut in it for the eyes, and to this is fastened a small piece of wood which the enameler holds in his teeth. Thus protected, the operator goes forth to enamel the tub.

It will also be noted that the room is quite high, and should never be less than 20 feet from the floor to the nearest roof beam. The enameling room should be isolated as much as possible to afford ample natural ventilation, but it has been the experience with most concerns that the furnace department is increased with the growth of the plant, and the enameling room is soon surrounded with other buildings.

Enameling Furnace.

The sliding furnace door, which is counterbalanced to facilitate operation, is clearly shown in Figs. 1 and 2. Two sheaves should be used to carry the weights over the top of the furnace to obviate their contact with the furnace. The weights can also be placed between the furnaces on extended arms running back to the operating shaft. On this type of door the guides at the side are hinged so that the door can be pressed against the front of the furnace and still be free to move by slightly opening these guides. The guides are made of cast iron, are of heavy section, and are hinged to the cast iron door frame. The hinge is loosely fitted, and when swinging shut, the lower end rests on the same cast iron ledge as the furnace door. The door is lined with fire brick set in fire clay, and is made about 6 inches wider and 3 inches higher than the furnace opening, so that the heat from the furnace will not melt the cast iron door frame in which the fire bricks are set.

Cooling Ovens.

The cooling ovens shown are used in almost every plant. They consist of an open brick chamber and are used for slowly cooling off the tubs. Small ware, however, is not cooled in this way. The chambers of these ovens are made large enough for one tub, which is permitted to remain in the oven to cool while another tub is

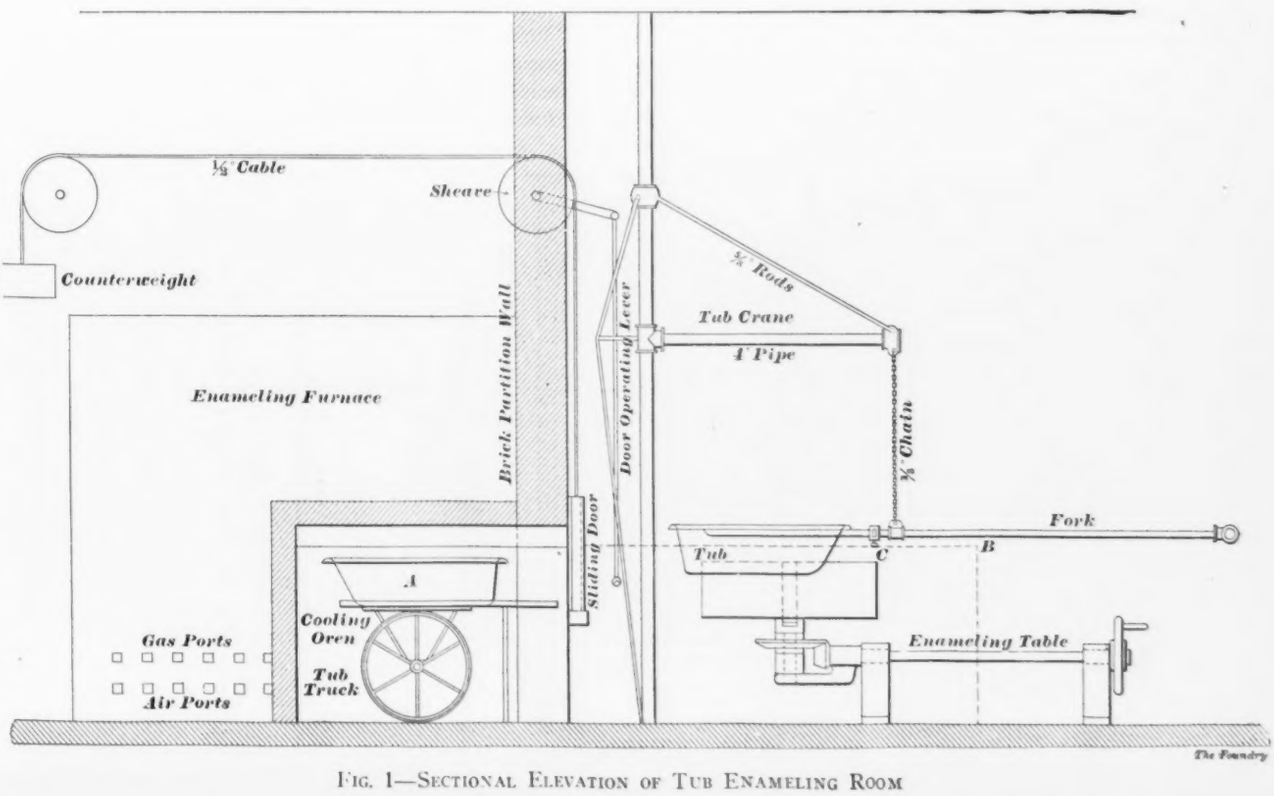


FIG. 1—SECTIONAL ELEVATION OF TUB ENAMELING ROOM

being enameled. Frequently, the tub castings run thin in spots and again the metal may be high in phosphorus, and as a result they crack when placed in the enameling oven. To obviate the possible cracking of these castings and to relieve the internal strains, the tubs are annealed in a furnace before the slush or enamel coats are applied. This operation is known as "burning out," and this practice is pursued in a number of plants. Small cracks are more liable to develop in the annealing furnace, and if the tub breaks at all, it is usually during the first heat. A handyman can perform this operation and this precaution materially increases the output of the enamelers, as it greatly reduces their losses.

Charging the Furnace.

The tub, suspended, ready to be placed in the furnace, is shown in Fig. 1. The fork is held by the handle, by one of the operators, to balance the tub. The cap screw, *C*, is used to adjust the prongs of the fork either in or out, to accommodate the various widths of the different types of tubs manufactured. Care should be exercised to put through the enameling room as many tubs of one size as possible. The foreman of the enameling room should be consulted, but unless those in charge of the cleaning room and foundry work in harmony with him, considerable changing of the enameling equipment for the various wares will result. These precautions should be taken, notwithstanding the piecework basis under which the enameling room is operated, inasmuch as both the quantity and the quality of the ware will be enhanced. The overhead expense is constant, and any increase in production reduces the proportion of the burden on every article manufactured.

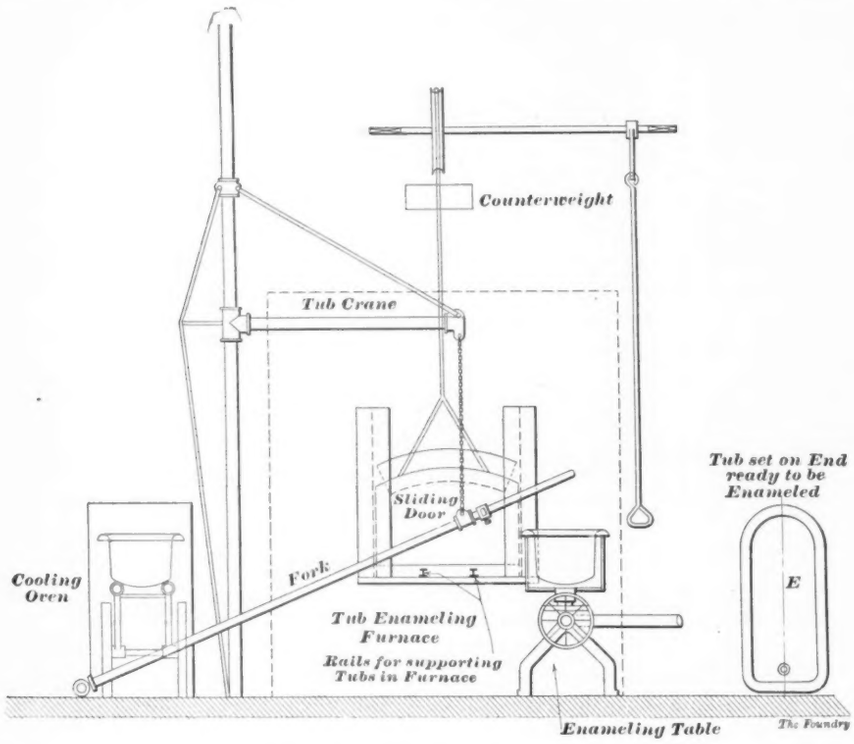


FIG. 2—FRONT ELEVATION OF TUB ENAMELING ROOM

Installation of Enameling Table.

When the tubs are delivered to the enameling room they are set up on their drain ends in a row, indicated by the dotted line *B*, Fig. 1, and as shown at *E*, Fig. 2. The enameling table is installed along the sides of the tubs, as shown, ample space being allowed between the table and the furnaces for the operator, who opens and closes the furnace door and who also sifts the enamel on the rim of the tub while the enameler is dredging the enamel over the surface of the remainder of the casting. As shown in Fig. 2, the table is located slightly at one side of the center of the furnace door. In some plants this device is placed directly in line with the furnace door, so that the tub may be taken out of the furnace and dropped onto the table without being compelled to move the tub sideways. The time of handling may be somewhat reduced by this method, but it brings the enameler in close contact with the furnace and consequently he is subjected to the direct heat radiated through the furnace opening.

In enameling rooms no standard space in front of the furnaces has been adopted by manufacturers. The space in front of the furnaces should not be less than 30 feet wide and 40 feet is recommended. The furnaces are built in a row and the space between them depends entirely on the type of furnace installed.

Crating Enameled Ware.

The crating of enameled ware is an exceedingly important item and is given careful attention by those in charge of these plants. Enamel will chip and break as easily as glass if not properly handled. Owing to the fact that the ware is made of cast iron, it is frequently carelessly handled and as a result the enamel is shattered. When

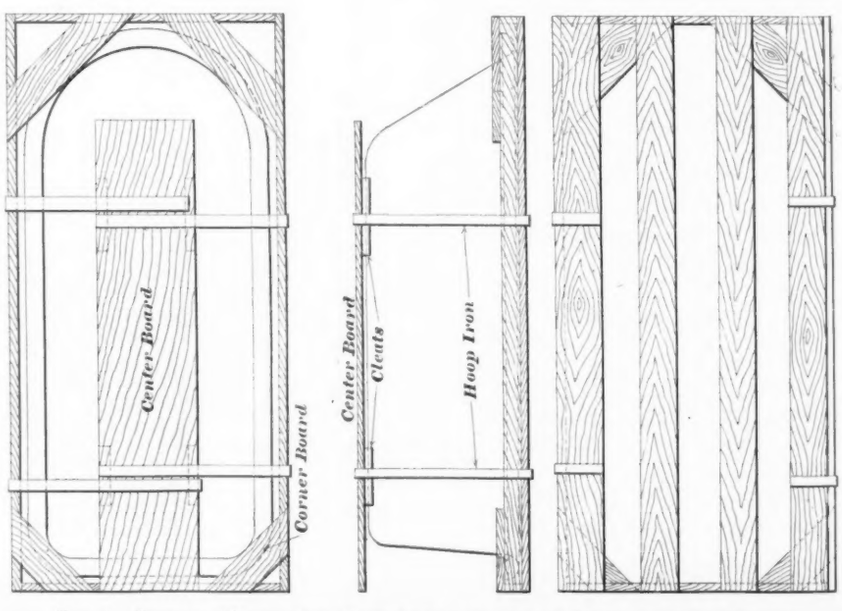


FIG. 3—BOTTOM VIEW, SIDE ELEVATION AND PLAN VIEW OF TUB CRATING

it is considered that many plumbers deliver sinks, lavatories, and even bath tubs, without affording them any protection, it is marvelous that the percentage of ware returned is not greater than the present losses on which manufacturers are compelled to pay rebates. One would generally suppose that if the ware were entirely boxed and packed with buffers, the problem of breakage in shipment would be solved. Experience, however, proves that the more carefully enameled ware is packed the more roughly it is handled by the railroads. This has led to the other extreme of packing in open crates, so that the men handling the goods can see the nature of the ware and will accordingly exercise due precautions. In addition, the purchaser has an opportunity of noting the condition of the ware before it is accepted from the transportation company. Notwithstanding all precautions, losses as high as 20 per cent, due to improper handling, are not unusual. For this reason, it is apparent that any reduction in these losses will materially increase profits. The open crate can be built at a lower cost than the one entirely inclosed.

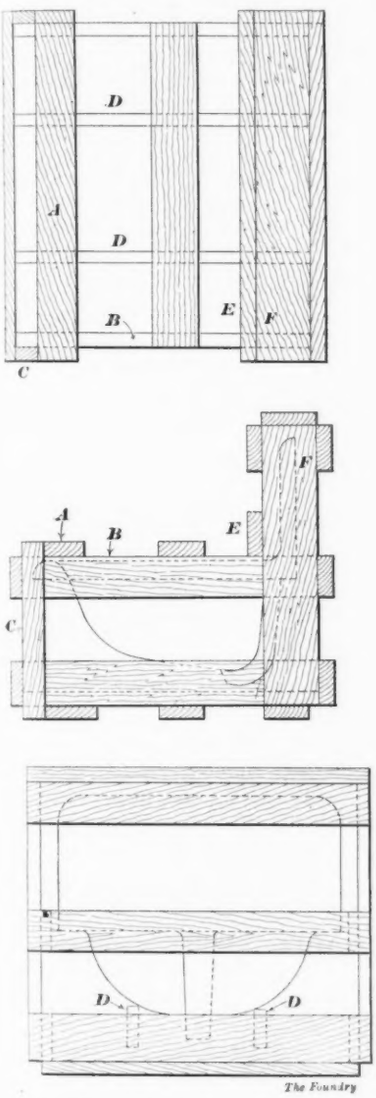


FIG. 4—PLAN VIEW, END ELEVATION AND SIDE ELEVATION OF LAVATORY CRATE

Building Crates.

When building crates for enameled ware the material should be cut and put together so that the nails are in shear. When a crate, thus built, is dropped repeatedly, the force produced by the weight of the article is always against the length of the nail instead of against the head. This construction can be attained at the corners of the crate. The method of building crates for lavatories is shown in Fig. 4. The corners are rigid, being strengthened by the three boards, *A*, *C*, and *B*, shown in the plan view. It will be noted that strip *A* is nailed to both *B* and *C*, and that *C* is nailed to both *A* and *B*, and that the nails have all been driven at right angles to each other. In the same manner the strip *E* is nailed to both *B* and *F*. When a crate is so constructed, each nail must be drawn unless the crate is destroyed in removing the ware. As the crates strike on the corners when they are unloaded, this cross-nailing develops the maximum strength of the crate. This type of crate construction has been adopted by a large number of manufacturers. Some concerns use strip steel known as hoop iron, twisted wire, and other metal ties, for holding the crates together. The expense of constructing crates in this way is correspondingly increased, but these metal ties are not used extensively for crating small ware. Hoop iron is almost invariably used in crating bath tubs.

Bath Tub Crate.

The bath tub crate is shown in Fig. 3. Some concerns entirely board over the top of the crate, while others permit it to remain open, as shown in the plan view. The top of the crate is built to fit the rim of the tub for which it is intended, with due allowance for excelsior to protect the tub from the sides of the crate. The top is held in position on the tub rim by four diagonal strips nailed across the corners underneath the rim. Only this section of the tub must be protected, and the center piece, shown in the bottom view of the crate, permits the tub to be set on end in the warehouse or the freight car. This board is held in place by hoop iron nailed to the top of the crate. As the top is secured to the rim by the diagonal bottom braces, the center board is held firmly in place by the metal ties. To prevent the center board from slipping sideways, four cleats are attached as shown in the bottom view.

Crating Material.

Crating material can be obtained in board lengths or the short lengths known as shooks. These shooks are cut to length in the saw mill, and greatly reduce the cost of preparing the material when purchased in board lengths. However, the shooks can be used for crating articles of a standard size, and considerable lumber must be carried in stock for crating ware for which the shooks are not provided. For cutting the boards to length, an overhead swinging saw is generally used, and the saw table is provided with an adjustable stop, so that the number of boards required can be cut to the same length. For ripsawing the lumber, a circular saw is used. The table should be elevated at the feeding end so that the boards, after being cut, will slide off the table, away from the saw.

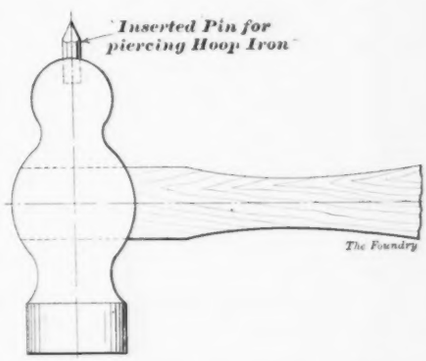


FIG. 5—HAMMER USED FOR PIERCING STEEL BANDS

Great economies can be effected when building these crates by reducing the number of operations required in their construction. The work can be divided among several men who build certain sections, while another gang assembles them. A form may be used in which the first course of lumber is placed, and this will insure the construction of crates of the same size. A ¼-inch steel plate should be placed underneath this form, which is screwed or nailed to the work bench. This plate will provide a level surface, and it also serves to turn the points of nails into the wood, thus obviating the necessity of turning over the section of the crate to clinch them. The nailing machine has not been used extensively in the construction of crates for

enameled ware, although a large amount of work could be done profitably on such a machine, especially when building crates for small ware.

Small Crates.

Small crates are built with two sides open and excelsior pads are used to prevent the enamel from coming in direct contact with the wood. These pads are made up of layers of excelsior of uniform length and thickness, and paper is wrapped around these pads, the outer edges being pasted to the ware. The paper wrapping holds the excelsior in place. When crating lavatories or high backed sinks, two cross pieces are set in the crate as shown in the side elevation, *D*, Fig. 4, which abuts against the bottom of the ware and prevents it from shifting.

The covers for bath tub crates are made on a side table and the feet are fastened in pairs in the center of the crate, with hoop iron. For piercing these iron strips a hammer with a ball pean, Fig. 5, is used, and into this pean is drilled a hole in which a round section of steel is driven, which is afterward pointed. This projects about ¼ inch and is used for piercing the iron before the nails are driven. This simple tool effects a great saving of time, as compared with the use of a punch.

Crating Tubs.

After the cover is made, it is placed on the floor at the side of the tub to be crated. The tubs in the crating room rest on their sides in a row, and are rolled over onto the covers and the corner boards are nailed in place underneath the rims. The center-boards are then laid on the bottoms of the tubs, and the steel strips are fastened to one side of these boards, which are tilted slightly, so that after being nailed and when pressed against the bottoms of the tubs, the hoops are in tension. The other metal strips are then gripped with a tool, which bears against the edge of the center-board, and while being held in position are nailed. The covers of the crates are then stenciled, the style, size, etc., being noted. It is advisable to use a brass stencil, and to keep it in shape and to facilitate handling as well as lining up with the edges of the boards, a hard wood strip should be attached to one side. For the customer's name a machine-cut paper stencil should be used. After crating, the ware is ready for shipment. Lavatories, sinks and small ware are handled on four-wheeled trucks with standards set in loosely at the ends. The bath tubs, before and after crating, are best handled on two-wheeled trucks.

Handling the Ware.

Some of the reasons assigned for favoring the handling of enameled ware on trucks as against overhead systems would indicate that it is not always possible to maintain a clear passage way, and in addition, the hauls are short and branching. Furthermore, if a continuous moving overhead system were installed, men would be required to do the loading at either end, and it was found that, owing to the short hauls, the ware could be conveyed on trucks, from place to place, almost as cheaply. The small ware can be handled by one man, and this facilitates the loading and unloading of the trucks.

In the manufacture of enameled cast iron sanitary ware, many improvements are constantly being made to reduce producing costs. The purchaser constantly demands better ware and more difficult shapes are constantly being designed. Appended are answers to a number of questions which have recently been submitted to the author.

The Use of Oxide of Tin.

Is it possible to make good enamel for cast iron without oxide of tin in the mixture?

Oxide of tin is the most expensive of the materials entering into the enameling mixture. For this reason it is desirable to eliminate it entirely or to substitute other materials for at least a part of this ingredient. A number of formulae have been compounded without the use of oxide of tin, but the resultant enamel does not have as fine a finish as an oxide of tin mixture. The first coat of enamel compounded without oxide of tin, dredged on the ware, should be heavy, and it should be finished with a light coat. When the enameler experiences difficulty in covering the ware with the first coat of enamel the difficulties are multiplied when the succeeding coats are applied. This enamel does not stand patching very well. The difference between an oxide of tin enamel as compared with one in which no oxide of tin is used, is marked. The latter has a dull appearance, and is not nearly as bright as the former. Oxide of zinc is frequently used to reduce the amount of oxide of tin in the mixture, but care must be exercised when using a mixture of this kind, as the patching properties are reduced in proportion to the amount of oxide of zinc used.

Cost of Machine-Made Tubs.

What is the saving effected by the use of molding machines for producing bath tubs, as compared with the hand molding method usually employed?

The reduction averages from 25 to 33 1-3 per cent of the hand molding cost, but the loss from machine-made molds is much higher than those produced by hand. The loss on machine-made castings will average approximately 10 per cent, and in some cases is as high as 20 per cent, while on floor work the loss frequently averages less than 5 per cent. On the other hand, the greatly increased production at a lower labor cost more than offsets this high percentage of losses. This saving on machine-molded ware is based entirely on the operation of a plant well equipped throughout to handle machine-made ware.

Sand-Handling Machinery.

Are the repairs on sand-handling machinery in cast iron sanitary ware plants excessively heavy, and how many men are required to operate these systems?

Sand-handling machinery must be especially built for the work for which it is intended. Most repairs on machinery of this kind are the result of the breakage of various parts, and this indicates that the machinery was not sufficiently well constructed, or that it was improperly designed. If the sand-handling machinery is properly built and designed, one man can easily take care of ordinary repairs for a plant making 300 tubs daily. It must not be forgotten that sand is an abrasive material, and as a result there is a rapid wear of all parts. Wearing parts should be so designed that they can easily be bored out if necessary and bushings inserted. Every wearing piece should be easily removable, so that it can be readily repaired, to reduce the time of repairs to the minimum.

The American Blower Co., Detroit, in a 32-page booklet, illustrates and describes the Sirocco electric fan and air purifier, which is intended for ventilating homes, offices, etc. The fan is operated by an exceedingly small electric motor, 1-70 of a horsepower, and consequently the consumption of electric current is very low. The capacity of the fan is 5,000 cubic feet of air per hour.

DETROIT'S SUPREMACY IN AUTOMOBILES

The City of the Straits is the world's greatest motor car producing center --- History of the rapid growth of this industry in southeastern Michigan

THE growth of the automobile industry in the United States during the last decade is unparalleled in the history of the business development of this country. Fifteen years ago, there were only five concerns that attempted to build self-propelled vehicles, and their combined output for that year was 70 cars, representing a value of $157,000. For the 1910 season it is estimated that no less than 200,000 cars will be built, valued at $275,000,000. These figures are stupendous and reflect the marvelous expansion of this industry over a period of a comparatively few years. In the Dingley tariff bill, adopted 12 years ago, the motor car was hidden away in the schedule of "manufactured metal," as it was not considered of sufficient importance at that time to give it a separate classification. In 1899, the value of the automobiles built in the United States was estimated at $1,290,000, and in 1905 this had increased to $42,000,000. The value of the output for 1909 has been placed at $135,000,000 and manufacturers have planned to double this during the present year. Up to 1906, France led the world in the production of automobiles, but in that year the United States wrested the position of supremacy from her leading competitor, and has never since been overtaken.

The largest output planned by one manufacturer in 1910 is 40,000 cars, while another contemplates building 30,000, and recently shipped 212 automobiles in one day in his effort to exceed his estimated output for the year. However, it is certain that the total number of cars built this year will fall far short of the estimates, owing to the difficulties experienced in obtaining material, and the attitude of labor is a factor that has troubled the manufacturer to no small extent.

Allied Industries.

The manufacture of automobile accessories has expanded in direct proportion to the growth of the automobile industry, and it is fair to assume that many millions of dollars have been invested in new plants for the manufacture of auto parts. The advent of the automobile has also had a distinct bearing on the development in the United States of alloy steels and bronzes of great strength, to meet the requirements of motor car construction. The tonnage of steel annually consumed in automobile construction has reached large proportions and consists principally of angles and small channels for frames, seamless steel tubing, sheets, etc. To reduce the weight of the cars, the foundryman has been called upon to make castings of unprecedented cross-section, and aluminum, owing to its low specific gravity, is in high favor for crank cases, gear cases, and other parts not subjected to severe stress. For several years, castings, notably gray iron cylinders, were imported in large quantities, as it was believed that the foreign product was far superior to that made in American shops. This fallacy has few followers today, however, and the largest importer of these parts is now preparing to install a foundry for the production of cylinder castings. The intricate design of many automobile castings for a time proved a problem to foundrymen who attempted to reap the rich harvest of this line of work. Today, however, the most difficult patterns are handled with comparative ease, and foundries making a specialty of this line of work, to a large extent, have replaced skilled labor with molding machines. The annual consumption of aluminum for casting purposes is growing rapidly, and is chiefly due to the heavy requirements of the automobile industry. One concern operating 12 foundries, in various sections of the country, has equipped its plants to meet the special needs of the motor car builders, and the output of aluminum castings for automobiles is estimated at 20,000,000 pounds annually.

Activity in Detroit.

While the early experiments with the motor car were not limited to any particular district in the United States, the greatest development of the industry has undoubtedly been attained in Detroit and immediate vicinity, where, according to the records, no less than 40 concerns are incorporated to engage in the manufacture of automobiles. In Detroit alone, 32 companies are operating automobile plants or contemplate engaging in this business before the end of the year. It has been asserted that Detroit is automobile crazy, but her great increase in bank clearances and her rapid growth in population controvert this assertion. The organization of a new company to build motor cars is no longer heralded as the news feature of the day, and the great influx of skilled workmen from shops all over the country no longer occasions surprise.

The total capitalization of the automobile manufacturing concerns in Detroit is close to $20,000,000, and the General Motors Co., which owns several Detroit plants, a large works at Flint, Mich., employing 8,000 men, as well as other companies in various sections of the country, is capitalized at $60,000,000. These figures, only in a limited way, reflect the importance of this industry to the City of the Straits, and the allied concerns engaged in the manufacture of accessories, that have been organized during the last few years, are too numerous to chronicle.

Labor Problem.

The problem of obtaining skilled labor by manufacturers throughout the Detroit district is growing more difficult of solution from day to day, and notwithstanding the increase in the wage-earning population of 12,000 during 1909, an acute demand exists for trained mechanics. Last year 25,000 workmen were found positions by the Employers' Association of Detroit, and places are now being found for men at the rate of 1,000 per month. While high wages are paid for competent help, it is doubtful if the rate of pay is above that prevailing in other large industrial communities, and the charge that Detroit manufacturers have raided the machine tool districts of the New England states and southwestern Ohio is emphatically denied. No concerted effort has been made to obtain workmen in any section of the country, and applications for positions for large gangs of men are refused by the Employers' Association. To those inquiring for employment a circular letter is addressed which outlines clearly the condition of the Detroit labor market. The important paragraphs of this communication are reproduced herewith:

"Present conditions are as set forth in our previous letter. Skilled mechanics, handymen, and men desiring to learn trades, are in demand, and every one of the numbers who has so far reported has been promptly directed.

"Wages, as we stated before, compare favorably with those paid in cities of similar size, in fact they are a little higher. They vary here as everywhere according to the trade, the man's experience and adaptability, and we cannot, therefore, quote to each inquirer the exact rate he would likely receive.

"Many have asked us to assure or guarantee immediate employment, on arrival in Detroit. Due to the fact that there are many responding in person, and indications from letters, of early arrivals, we can only assure you of our earnest efforts in your behalf. In other words, we will do all we can for you, but cannot guarantee immediate service or a definite rate."

Wages.

Being pressed for deliveries, and in their anxiety to obtain help, some of the Detroit concerns, notably the automobile shops, began bidding for the services of the skilled mechanics, and as a result the wage basis, for certain crafts, mounted to so high a level that it became imperative to eliminate this abuse by concerted action. As a result, there are not nearly so many changes among the employes of the various plants as heretofore, and wages are practically stationary. Common labor is paid $2.00 per day, and not only are the motor-car builders suffering from a shortage of this grade of help, but other industries as well. The tremendous increase in the wage-earning population is reflected in the soaring real estate market, but in the outlying towns, where large automobile plants have been established, and notably at Flint, a sufficient number of homes cannot be provided for the workmen. Tents and other temporary structures are utilized, and even during the winter months this was the only shelter that could be given many of the men. Hundreds of dwellings are being erected at Flint, but the building movement cannot keep pace with the rapid increase in population.

Capitalizaticn of Detroit Motor Car Builders.

Since the first of the year fully a dozen concerns have been organized in Detroit to manufacture motor cars, and it is almost impossible to present a complete list, in view of the fact that new companies are being projected almost daily. While the total capitalization of these companies is close to $20,000,000, it is estimated that their plant investment will far surpass this figure. A list of the Detroit automobile builders, together with their authorized capital, is given below.

Detroit Automobile Manufacturers.

Name.	Capital.
Abbott Motor Co.	$ 300,000
American Motor Truck Co.	100,000
Anderson Carriage Co.	1,200,000
Ajax Motor Wagon Co.	5,000
Bailey Motor Truck Co.	100,000
Beyster-Detroit Motor Car Co.	250,000
Brush Runabout Co.	310,000
Cass Motor Truck Co.	300,000
Cadillac Motor Car Co.	1,500,000
Chalmers-Detroit Motor Co.	300,000
Demotcar Sales Co.	100,000
Detroit-Dearborn Motor Car Co.	100,000
Detroit Electric Vehicle Co.	500,000
E-M-F Co.	1,000,000
Ford Motor Co.	2,000,000
Grabowsky Power Wagon Co.	.....
Herreshoff Motor Co.	140,000
Hudson Motor Car Co.	100,000
Hupp Motor Car Co.	250,000
Lotz Auto Co.	300,000
Metzger Motor Car Co.	500,000
Michigan Motor Truck Co.	1,000,000
Oliver Motor Car Co.	300,000
Packard Motor Car Co.	10,000,000
Paige-Detroit Motor Car Co.	.....
Regal Motor Car Co.	1,000,000
Robinson Motor Car Construction Co.	20,000
Sibley Motor Car Co.	80,000
Stuart Commercial Car Co.	300,000
T-H-T Motor Car Co.	100,000
Welch Company of Detroit	.....

Automobile Manufacturers Within a Radius of 75 Miles of Detroit.

Buick Motor Co.	Flint, Mich.
Cartercar Co.	Pontiac, Mich.
Jackson Automobile Co.	Jackson, Mich.
Oakland Motor Car Co.	Pontiac, Mich.
Oldsmobile Co.	Lansing, Mich.
Rapid Motor Vehicle Co.	Pontiac, Mich.
Reliance Motor Car Co.	Owosso, Mich.
Reo Motor Co.	Lansing, Mich.

Output of Cars in 1910.

From reports received from 23 concerns in the Detroit district it would seem that very few cars for the 1910 season would be built by manufacturers located in other sections of the country. The total estimated output of these plants for this year is 179,100 cars, but it is certain that the production of many of the plants will fall short of the estimate owing to the difficulties experienced in obtaining material, labor, etc. On the other hand, the Ford Motor Co. is exceeding its estimate and recently shipped 212 cars in one day. The General Motors Co. recently announced that it produced 11,545 cars during the first three months of this year, of which 6,478 were made at the Buick plant at Flint, and 2,851 at the Cadillac plant in Detroit. Conservative figures place the country's production for this season at 125,000 cars, which would mean a reduction of the contemplated output of motor car builders in the Detroit district, given herewith, of about 50 per cent:

Estimated Output of Cars for the 1910 Season by Automobile Manufacturers of Detroit and Vicinity.

Name.	Cars.
Anderson Carriage Co., Detroit	1,500
Brush Runabout Co., Detroit	10,000
Buick Motor Co., Flint, Mich.	25,000
Cadillac Motor Car Co., Detroit	12,000
Cartercar Co., Pontiac, Mich.	3,000
Chalmers-Detroit Motor Co., Detroit	6,500
Demotcar Sales Co., Detroit	3,000
Detroit-Dearborn Motor Car Co., Detroit	500
E-M-F Co., Detroit	40,000
Ford Motor Co., Detroit	30,000
Grabowsky Power Wagon Co., Detroit	900
Hudson Motor Car Co., Detroit	5,000
Metzger Motor Car Co., Detroit	2,500
Oakland Motor Car Co., Pontiac, Mich.	7,000
Packard Motor Car Co., Detroit	3,000
Paige-Detroit Motor Car Co., Detroit	3,000
Rapid Motor Vehicle Co., Pontiac, Mich.	5,000
Regal Motor Car Co., Detroit	5,500
Reliance Motor Car Co., Owosso, Mich.	1,200
Reo Motor Car Co., Lansing, Mich.	8,000
Sibley Motor Car Co., Detroit	2,000
Warren Motor Car Co., Detroit	2,000
Welch Company of Detroit, Detroit	1,000
Total	179,100

Consolidations.

That the automobile industry has already reached the consolidation stage is shown by the organization of the General Motors Co. and the United States Motor Co. The former merger was projected by the organizers of the Buick Motor Co., at Flint, and is capitalized at $60,000,000, of which $20,000,000 is cumulative 7 per cent preferred stock and $40,000,000 common. The headquarters of the General Motors Co. are at 103 Park avenue, New York City, and officers are as follows: W. M. Eaton, president; W. C. Durant and W. J. Mead, vice presidents; Curtis R. Hathaway, secretary and treasurer; H. S. Hamilton, John T. Smith and Henry Henderson, together with the officers, constitute the board of directors. Earlier in the year the output of this combination for the 1910 season was placed at 60,000 cars. The companies absorbed are presented herewith:

Buick Motor Co., Flint, Mich.
Olds Motor Works, Lansing, Mich.
Reliance Motor Truck Co., Owosso, Mich.
Michigan Auto Parts Co., Detroit.
Northway Motor & Mfg. Co., Detroit.
Oakland Motor Car Co., Pontiac, Mich.
Cadillac Motor Car Co., Detroit.
Marquette Motor Car Co., Saginaw, Mich.
Rapid Motor Vehicle Co., Pontiac, Mich.
Cartercar Co., Pontiac, Mich.
Michigan Motor Castings Co., Flint, Mich.
McLaughlin Motor Car Co., Oshawa, Ont.
Weston-Mott Co., Flint, Mich. (Interest in.)
Welch Motor Car Co., Pontiac, Mich. (Interest in.)

While large extensions are being made from time to time at the Buick plant at Flint, a site has already been purchased for the erection of a large plant at Detroit, which promises to be the largest automobile factory in the world.

United States Motor Co.

The United States Motor Co. is capitalized at $16,000,000 and is a merger of the three plants of the Maxwell-Briscoe Motor Co., located at Tarrytown, N. Y., Newcastle, Ind., and Providence, R. I.; the Columbia Motor Car Co., Hartford, Conn., and the Alden Sampson Mfg. Co., with plants at Pittsfield, Mass., and Detroit. The capitalization of the Alden Sampson Co., recently purchased, has been increased from $300,000 to $2,000,000, and this branch of the United States Motor Co. has decided to enter the commercial vehicle field on a large scale. Plans have been prepared for the erection, at Detroit, of the largest commercial car plant in the country, at a cost of approximately $700,000, and the 1911 output is placed at 4,000 light delivery wagons. The officers of the United States Motor Car Co., are as follows: Benjamin Briscoe, president; J. D. Maxwell, Horace De Lisser and

H. W. Nuckols, vice presidents; Carl Tucker, treasurer; F. D. Florence, secretary, and Richard Irwin, chairman of the finance committee.

Selden Patent.

In view of the legal contest that has been waged in the courts for a period of more than six years over the validity of the Selden patent, a brief review of this case will throw considerable light upon the history of the early development of self-propelled vehicles. On May 8, 1879, George B. Selden, a lawyer of Rochester, N. Y., applied for a patent for a gas compression engine for propelling road vehicles. On Nov. 5, 1895, he was granted a patent on an improvement in road engines, and it is his claim that every vehicle built since that time is an infringement on his patent rights. The validity of this patent is admitted by many builders of motor cars who are members of the Association of Licensed Automobile Manufacturers. The royalty paid is reported to be eight-tenths of one per cent of the catalog price of the car, three-fifths of this amount being paid to the holders of the Selden patent, while two-fifths is retained by the association. This arrangement, however, was changed, and the holders of the patent, according to reports, are paid the sum of $150,000 annually, and all in excess of this amount will be retained by the association. The validity of the Selden patent was sustained in a decision handed down by Justice Hough, in the United States Circuit Court, Southern District of New York, on Sept. 15, 1909. The elements of the combination shown in the Selden patent are as follows:

1—A "road locomotive," having suitable running gear and propelling wheel and steering mechanism.
2—A "liquid hydrocarbon gas engine of the compression type," comprising one or more cylinders.
3—A liquid fuel receptacle.
4—A power shaft, arranged to run faster than the propelling wheel.
5—An intermediate clutch or disconnecting device.
6—A suitable carriage body, adapted to the conveyance of persons or goods.

Licensed Association.

More than 40 automobile manufacturers are affiliated with this association, which has its headquarters at No. 7 East Forty-second street, New York City. The officers are as follows: Charles Clifton, George N. Pierce Co., Buffalo, president; Thomas Henderson, Winton Motor Carriage Co., Cleveland, vice president; L. H. Kittredge, Peerless Motor Car Co., Cleveland, secretary, and George Pope, Pope Mfg. Co., treasurer.

In a recent announcement, made by the General Motors Co., giving the output of ten of its plants during the first three months of this year, it was stated that the royalties on 11,545 cars produced, paid to the association, amounted to $157,793.92. The output of the Buick plant at Flint was 6,478 cars as against 4,437 cars during the last quarter of 1909, an increase of 46 per cent.

Growth of Motor Car Plants.

There are few automobile plants in Detroit that are not constantly being extended and enlarged, and new works spring up mushroom-like in all sections of the city. The plant of the Packard Motor Car Co. has grown from a factory of 2½ acres of floor space in 1904 to 21 acres, with four acres under construction. This concern reports that never in its history has there been a week in which additions of some kind were not under way. The number of people employed approximates 6,000.

The E-M-F Co., during the last few months, has completed three new buildings, each 470 feet long, 70 feet wide and three stories high, and at its De Luxe plant in Detroit, two four-story additions were made, 621 x 60 feet, and 200 x 60 feet. A testing shop was also built, 200 x 70 feet. On Sept. 26, 1908, the E-M-F factory consisted of a plant of three floors, 50 x 490 feet and today the works have 33 acres of floor space and employ 8,500 men. The Ford Motor Co. has also enjoyed a remarkable growth, having completed, within a year, a large plant on Woodward avenue.

The Chalmers-Detroit Motor Co., at the conclusion of the 1909 selling season, began additions in the form of new buildings, including two structures 60 x 400 feet, four stories high. These extensions have been completed and treble the capacity of the original plant.

The Metzger Motor Car Co., organized less than a year ago, occupies a plant covering 135,000 square feet of floor space and the equipment represents an outlay of $250,000.

The Regal Motor Car Co. increased the size of its plant 200 per cent to take care of its 1910 quota of cars and the factory now covers 500,000 square feet of floor space. Provisions for a still larger plant for the 1911 season have been made and ground has already been broken for additions which will double the size of the plant.

Other Extensions.

The rapid growth of the industry in Detroit is indicated by these illustrations, which might be continued to include practically every motor car factory in Detroit and southeastern Michigan. Owing to the heavy demand for castings to meet the requirements of the automobile trade, many new shops have been built during the last few years, and Detroit now ranks with the leading foundry centers of the United States. The orders for castings are of large proportions, one concern having contracted for 30,000 cylinders for this season with a Detroit foundry. The demand for malleable castings for motor car construction is also growing, many parts, as well as the hubs, now being cast of this metal. The size of some of these orders is indicated by a contract for 1,000 tons of hubs, recently placed with one malleable foundry. As a brass foundry center, Detroit takes first rank, and this industrial community can now boast of the largest aluminum casting plant in the United States. A large drop forge plant is also under erection to meet the local requirements, and factories manufacturing accessories are constantly being extended to meet the demands of the automobile builders.

Development of the Industry in Detroit.

The centralization of this great industry in Detroit is not entirely due to the unexcelled shipping facilities or natural advantages of the city, as will be shown by tracing the development of this business in southeastern Michigan. By some it is asserted that the Olds Motor Co. may be considered the father of the industry in Detroit. Many of the successful concerns have been organized by men who were previously connected with other manufacturers of automobiles.

One of the first horseless carriages was the Oldsmobile, and employed in the Olds plant, so the story goes, were Roy Chapin, John D. Maxwell, Walter Morley and Howard Coffin, all of whom have since taken leading parts in the development of other motor car concerns. The engines for the Oldsmobile were manufactured for some time by Leland & Faulconer, since absorbed by the Cadillac Motor Car Co. A. P. Brush was employed in this shop and later, when the Olds company decided to build its engines, the Cadillac company was organized with Mr. Brush as designer. Some early experiments for those interested in the Cadillac company had been conducted by Henry Ford, at that time superintendent of the Edison company's illuminating plant. Mr. Ford later organized the company which bears his name, and in the meantime John D. Maxwell, one of the original Olds group, together with William Barbour, organized the Northern Auto Co.

Some of the first parts for the Oldsmobile were made by the Briscoe Mfg. Co., and through this work the Briscoes joined forces with John D. Maxwell, who had left the Northern Auto Co. Briscoe and Maxwell organized the Maxwell-Briscoe Co., which is now a part of the United States Motor Co.

Frank Briscoe later formed a business connection with A. P. Brush, who severed his connection with the Cadillac company, and the Brush Runabout Co. was formed.

History of Other Companies.

Other Detroit capitalists now became interested in the industry, and Henry B. Joy and Fred Alger organized the company which purchased an automobile manufacturing concern at Warren, O., which has developed into the Packard Motor Co., of Detroit. David Buick, together with the Briscoes, organized a company to build engines for motor cars, and one of the first contracts closed was with the Flint Wagon Works, Flint, Mich., and from this connection originated the Buick car and the appearance of W. C. Durant in the automobile field. It is further related that Walter Flanders, superintendent of the Ford company, became connected with the manufacturers of the Wayne automobile, and together with Mr. Everett and Mr. Metzger formed the Everett-Metzger-Flanders Co., now known as the E-M-F Co. The Chalmers-Detroit Motor Co., it is asserted, owes its origin quite definitely to the Olds company. It was chiefly started by Coffin, Chapin and James Brady, who were employed by the Oldsmobile Co., and as a result of the consolidation with the E. M. Thomas Co., Buffalo, the Thomas-Detroit Co. was organized. Later Hugh Chalmers, who had been connected with the National Cash Register Co. for many years, bought the Thomas interests in this concern and the name was changed to the Chalmers-Detroit Motor Co. Among the other employes of the original Olds company was Henry Hupp, who, together with others connected with this concern, joined with Clayton & Lambert and organized the Regal Motor Car Co. From this concern Mr. Hupp later departed and was the moving spirit in the organization of the Hupp Motor Car Co.

Building a Foundry on a Confined Site

THE new foundry of the Tarrant Foundry Co., which will be located at Seventeenth and Robey streets, Chicago, presents several very interesting features, as it is situated in the heart of the city, and the value of the real estate, as well as the track elevation requirements, were problems demanding the most careful consideration, the solution of which shows how obstacles may sometimes be overcome and prove to be important financial advantages.

Fig. 3, which is a plan view, shows how every square foot of the expensive real estate was utilized, and the cross-section, Fig. 2, illustrates how the track elevation was taken advantage of by incorporating about 270 feet of elevated spur track in the plans, which represented a saving on the charging floor alone of 5 per cent on the entire cost of the plant.

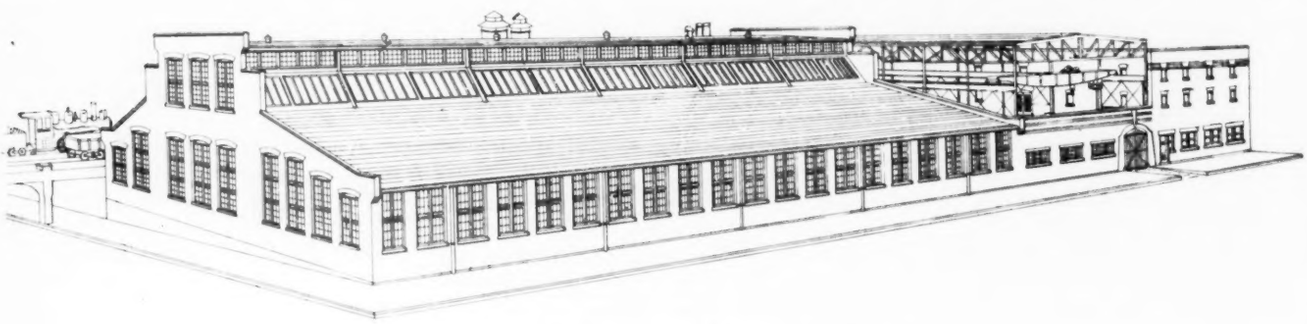


FIG. 1—THE NEW PLANT OF THE TARRANT FOUNDRY CO.

The Foundry Building.

The foundry building, Fig. 1, is 141 x 200 feet, and is built of steel, reinforced concrete and brick, the center crane span being 60 feet wide, with the crane rails 25 feet above the floor, over which will operate a 15-ton traveling crane. One side bay is 45 feet wide and is commanded by a 10-ton crane. The other bay, in which is located the core room, is 28 feet wide and will be commanded by a 5-ton crane.

The cupola charging floor parallels the elevated track at car height, thus eliminating the necessity of elevating the material. It is 128 feet long and 31 feet wide, and is designed to carry a load of 2,000 pounds per square foot. The pig iron will be delivered directly from the cars to the stock piles on the charging floor, through 13 rolling steel doors, which also furnish free access to the coke storage.

The metal is weighed and carried to the cupola by means of an industrial railway system equipped with scale cars. The cupolas are two in number, of 66 and 84 inches diameter respectively, and the blast will be furnished by two motor-driven, positive pressure blowers. An elevator will be installed to carry the gates and scrap from the chipping room to the charging floor.

The construction of the elevated siding is partially shown in Fig. 2, the heavy train load being sustained by a substantial steel structure between the special retaining wall and the foundry building. The floor of the elevated structure is of reinforced concrete slabs, which are graded for drainage, and furnish a weather proof floor between the building and the main line elevation, as well as a roof protection for the storage rooms below.

Iron trap doors are placed in the floor, permitting core sand to be delivered to the coremakers, and the molding sand to a point accessible to the molding floors. All other supplies are also thus delivered to their properly assigned places. The two core ovens, which are 7 x 18 feet and 9 x 18 feet, respectively, and a mold drying oven, 15 x 27 feet, are located under the track, as shown in the plan view, Fig. 3.

Handling the Castings.

The castings will pass from the foundry through the cleaning rooms, 30 x 35 feet, and 16 x 16 feet respectively, to the yard, which is completely commanded by a traveling crane covering both yard and side track, that shipments may be made either by rail or truck. This yard crane has a span of 55 feet 8 inches, the rails being 32 feet 7 inches above the yard level. Its capacity is 15 tons and the crane runway is entirely under roof and extends from the Seventeenth street front-

ge, 160 feet across the yard and also erves the flask storage, which is on the trengthened cleaning room roof, concealed behind the street wall.

The pattern storage and office building is of reinforced concrete, three stories in height, 50 x 56 feet, and the plans include a small stable, which is also of reinforced concrete, even to the stall partitions and feed boxes. The small cupola in the old plant which was operated for 26 years at Indiana and Kingsbury streets, will probably be utilized, as well as one or two of the lighter cranes, but the rest of the equipment will be new. The estimated cost of the plant is approximately $100,000, plans for which have been prepared by Raeder & Wood, Chicago.

BAYONNE STEEL CASTING CO.

The Bayonne Steel Casting Co., 30 Church street, New York City, has purchased a site of five acres at Bayonne, N. J., and will erect a plant for the manufacture of steel castings. The location enables the company to have shipping facilities on three railroads and by water. The company will make converter steel castings, and expects to produce from 400 to 500 tons a month. The main foundry building will have 30,000 square feet of molding floor space. Other buildings of ample proportions will be erected for cleaning, sand blasting, pattern storage, etc., and it is hoped to have the plant ready for operation early in August.

It is the intention of the company to supply steel castings to the shipbuilding and dry dock concerns around New York harbor, and to make railroad and miscellaneous machinery steel castings. The organizers of the company are men well known in the steel foundry business, all of them having been identified with the industry for a great many years. The president is William D. Sargent, president of the Q. M. S. Co. and the Reading Steel Castings Co.; the vice president is J. Turner Moore, vice president of the Reading Steel Castings Co., and the secretary and treasurer is D. W. Yeckley, also of the Reading Steel Castings Co. The company will be managed by A. E. Williamson, formerly secretary and sales manager of the New Jersey Steel Co., Rahway, N. J. The works manager will be C. E. Chapple, formerly assistant to A. W. McArthur, president of the New Jersey Steel Co.

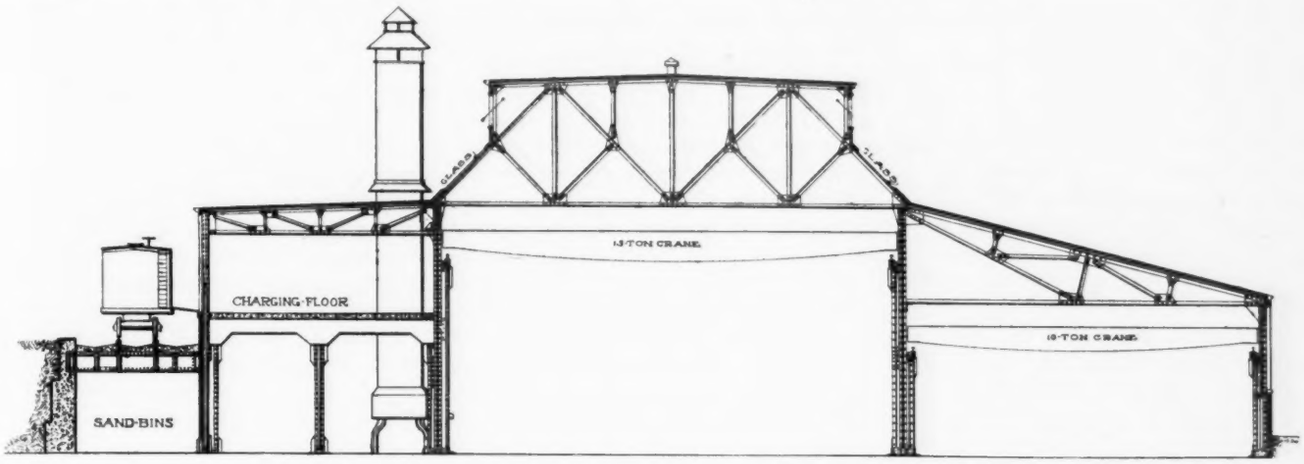


FIG. 2—CROSS-SECTION OF THE FOUNDRY AND THE ELEVATED SPUR TRACK

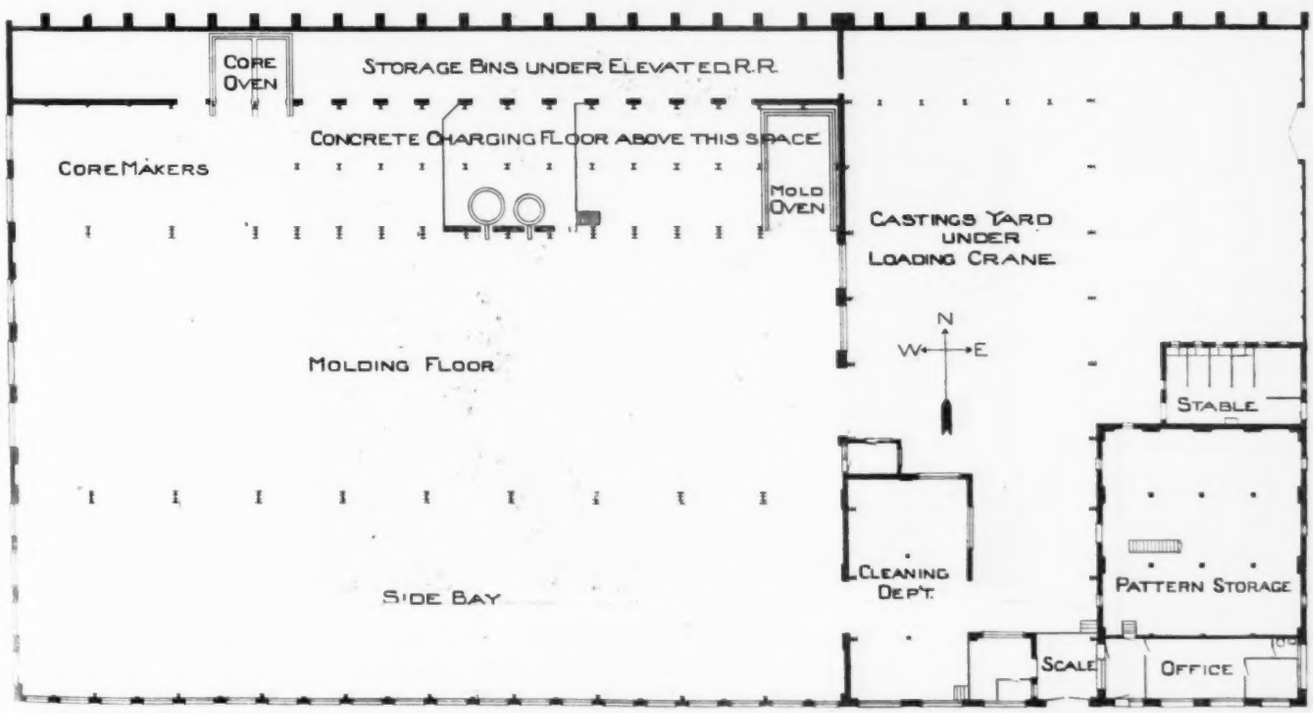


FIG. 3—PLAN VIEW OF THE FOUNDRY

FOUNDRYMEN'S CONVENTION AT DETROIT

Program of events during Founders' week in the beautiful City of the Straits --- Exposition of foundry supplies and equipment

DETROIT foundrymen, for the second time in the history of the American Foundrymen's Association, will extend the hand of welcome to the members of this society and its allied organizations during the week of June 6. It was in the beautiful City of the Straits that the first convention of American foundrymen was held, in May, 1897, although a permanent organization was effected in Philadelphia the previous year. The attendance of several hundred foundrymen at this first annual meeting reflected the intense interest that prevailed, at that time, in the advancement of the foundry industry, and foreshadowed a rapid growth for the society. That its organizers planted the seed in good soil is indicated by the present large membership enrollment and the attendance at the conventions has increased from hundreds to thousands. The organization of the three allied societies—the American Brass Founders' Association, the Associated Foundry Foremen and the Foundry & Manufacturers' Supply Association—was fostered by the parent body, and all four have one aim —the educational advancement of the foundry industry. Nor did the manufacturers of foundry supplies and equipment overlook the opportunity presented by the first gathering of foundrymen to display their products, and this feature of these meetings has become so extensive that more than 30,000 square feet will be devoted to exhibits at the coming convention. The entertainment program outlined measures up to Detroit's reputation for hospitality, and no city affords greater opportunities for pleasant sight-seeing tours. Always pre-eminent as a stove manufacturing center, Detroit now ranks fifth among the leading cities of the country in number of foundries. Arrangements have been made with every shop to receive delegations on tours of inspection during Founders' week, and the practice of many of these plants will prove of interest to the visiting foundrymen, especially the shops producing the intricate castings used in the construction of automobiles. Within a period of less than a decade, Detroit has become the greatest motor car manufacturing center in the world, no less than 32 plants, with an invested capital of nearly $20,000,000, being engaged in this industry in this city. Detroit also ranks first among the non-ferrous metal castings producing centers of the country and is the home of the largest aluminum foundry in the world.

MAJOR JOSEPH T. SPEER, OF PITTSBURG, WHO HAS THE INDORSEMENT OF THE MEMBERS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION FOR THE PRESIDENCY OF THIS SOCIETY

The opening of the exhibition of foundry supplies and equipment, held under the auspices of the Foundry and Manufacturers' Supply Association, at the Michigan State Fair Grounds, on Monday morning, June 6, is the first event on the Founders' week program. In the evening, a dinner will be tendered the officers of the various associations and the representatives of the technical press, at the Hotel Pontchartrain. The opening sessions of the annual meetings of the American Foundrymen's Association and the American Brass Founders' Association will be held jointly on Tuesday morning in the Michigan State building at the Fair Grounds. In this building, which is admirably located, with large verandas on both floors, the registration headquarters will be located, and in its spacious assembly hall all of the professional meetings of the two societies will be held. With the exception of the first session, separate meetings of the American Foundrymen's Association and the American Brass Founders' Association will be held, but they are scheduled for different hours, so that the members of these organizations can have an opportunity of attending the meetings of either or both of these societies. The closing session of the American Foundrymen's Association will not be held on Friday morning, owing to the large number of papers that are to be presented. The program has been so arranged

that there will be ample time for discussion, and the addresses are all on live topics that will prove of interest to every foundryman.

On Tuesday evening, a smoker will be tendered the visiting foundrymen at the Light Guard Armory, by the Detroit Foundrymen's Association, and the committee in charge of this affair promises many pleasant surprises. On Wednesday afternoon, a trip on the Detroit river on the steamer Brittania is scheduled, and stops will be made at the Semet - Solvay coke ovens and the blast furnace plant of the Detroit Iron & Steel Co. The visit to the latter works will be timed to give the foundrymen an opportunity of witnessing a cast. The trip down the river will be continued to the Livingstone channel, where the United States government is carrying on extensive work. In the evening, there will be a moonlight excursion and music will be provided for dancing. For the visiting ladies, an extensive entertainment program has been outlined, which includes a theatre party at the Temple Theatre, on Tuesday evening, and an automobile sight - seeing trip to points of interest on Thursday afternoon. The ladies' headquarters will be at Parlor H, of the Pontchartrain Hotel, where members of the ladies' committee of Detroit will be present at all times to give necessary assistance and information to the visitors. To prepare plans for the ladies' entertainment, a dinner was given at the Fellowcraft Club, Detroit, Monday evening, May 16, which was attended by the chairmen and members of all local committees, together with their wives.

Headquarters of the American Foundrymen's Association and the American Brass Founders' Association will be at the Pontchartrain Hotel, and the members of the Foundry and Manufacturers' Supply Association have selected the Cadillac. The plant visitation committee will have its headquarters at the Fair Grounds during the day and at the Pontchartrain in the evening. Passes will be issued to those desiring to visit local foundries and the committee is having a special map and folder prepared to aid the visitors to locate the various plants. One of the features of the week's proceedings will be the organization of a commission to make the annual award of a gold medal for the most notable achievement in foundry work during the previous year.

The exposition will surpass all previous efforts of the Foundry and Manufacturers' Supply Association. Displays will be made by no less than 85 concerns and the space reserved aggregates 30,000 square feet, nearly twice the area required for any previous show. The Main, Horticultural and Administration buildings at the Fair Grounds have been set apart for the exhibits, and in addition a tent, 30 x 120 feet, will be utilized. The display of molding machines will be unusually complete and will include mechanical molding devices for producing castings ranging in weight from a few ounces to 25 tons. Furnaces, core ovens, etc., will be shown in operation in the tent, where molds made on the machines in the Horticultural building will be cast. The two silver loving cups, donated by THE FOUNDRY, which will be awarded to the concerns making the best operating and still exhibits, respectively, will be displayed in THE FOUNDRY booth in the Administration building. A committee of five visiting foundrymen will be appointed by President F. N. Perkins, to make the awards, announcement of which will be made before the end of the week. The attendance, from present indications, will be greater than at any previous convention of these associations. A large delegation will leave Pittsburg Monday night, June 6, arriving in Detroit the following morning, while the Chicago

Convention Program

Opening Session, Tuesday, June 7, 10 a. m.

Addresses of welcome and responses.
Presidential address, Arthur T. Waterfall, for the American Foundrymen's Association.
Presidential address, William R. Webster, for the American Brass Founders' Association.
Secretary and treasurer's report, W. M. Corse, for the American Brass Founders' Association.
Secretary and treasurer's report, Dr. Richard Moldenke, for the American Foundrymen's Association.
"Acetylene-Oxygen Repairs in the Foundry," with an exhibition of the art as practically applied, by Steelman Stephenson.

Tuesday, 2 p. m.

AMERICAN BRASS FOUNDERS' ASSOCIATION.
"Analysis of Lead in Brass Alloys," by C. P. Karr.
"Fluxes as Applied to the Brass Foundry," by William R. Sperry.
"Use of Magnesium in Deoxidizing Aluminum Alloys," by H. M. Lane.

Tuesday, 3 p. m.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
"Foundry Efficiency," by Benjamin D. Fuller.
"The Personal Equation in Accidents," by Thomas D. West.
"The Permanent Mold," illustrated by lantern slides, by Edgar Allen Custer.

Tuesday Evening.

Smoker given by the Detroit Foundrymen's Association at the Light Guard Armory.
Theater party for the ladies at the Temple theater.

Wednesday, June 8, 10 a. m.

AMERICAN BRASS FOUNDERS' ASSOCIATION.
"Foundry Practice," by Jesse L. Jones.
"Electric Power Required to Melt Brass, Bronze, Etc.," by Prof. J. W. Richards.
"Electric Furnaces for Melting Non-Ferrous Alloys," by A. L. Marsh.

Wednesday, 11 a. m.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
Report of the committee on chemical standards for iron castings, by Prof. J. J. Porter.
"Physics of Cast Iron," H. M. Lane.

Wednesday, 2 p. m.

Boat ride on the Detroit river. Stops will be made at the Semet-Solvay coke ovens and at the blast furnaces of the Detroit Iron & Steel Co.

Thursday, June 9, 10 a. m.

AMERICAN BRASS FOUNDERS' ASSOCIATION.
"The Value of the Association to Its Members," by Dr. Frank T. F. Stephenson.
"Co-Operative Course of Metallurgy," by Prof. J. J. Porter.
"Cost and Cost Systems Applied," by C. R. Stevenson.

Thursday, 11 a. m.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
"The Shockless Jarring Machine," by Wilfred Lewis.
"The Universal Principle of Efficiency and Rational Organization Applied to Foundry Practice," by S. D. Emerson and W. J. Powers.

Thursday, 2 p. m.

Automobile sight-seeing trip for the ladies.
AMERICAN BRASS FOUNDERS' ASSOCIATION.
Unfinished business, election of officers, and new business.

Thursday, 3 p. m.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
Reports of committees, unfinished business, election of officers, and new business.
"Overhead Tramrail System for the Foundry," illustrated by lantern slides, by A. W. Moyer.
"The Electric Furnace," illustrated by lantern slides, by H. M. Lane.

Friday, June 10, 10 a. m.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
"Foundry Transportation Methods," by David Gaehr.
Report of the Committee on Industrial Education, presented by Paul Kreutzpointner.
"Specifications for Foundry Coke," by Dr. Richard Moldenke.
Discussion of continuous conveying methods and the foundry mixer.

Foundry Foremen's Association has chartered a special train and will be joined at Chicago by foundrymen from Milwaukee and St. Louis. This train will leave at noon, Sunday, June 5, arriving in Detroit the same evening. At the meeting of the Chicago organization, held on Saturday evening, May 14, in the rooms of the Western Society of Engineers, Dr. Frank T. F. Stephenson, chairman of the Detroit general committee, gave an illustrated talk on the interesting features of the City of the Straits. Views of many of Detroit's largest industrial plants were thrown on the screen and the officers of the allied foundry organizations were pictorially introduced to the members.

St. Louis Foreman's Association.

On Saturday evening, May 7, the St. Louis Foundry Foremen's Association was organized at a meeting held at the Missouri Athletic Club, which was attended by a large number of foundrymen, foremen and superintendents. A temporary organization was effected as follows: J. P. Pero, superintendent Missouri Malleable Iron Works, chairman, and W. S. Gemmer, superintendent St. Louis Car Wheel Co., secretary. J. E. Vollmar, of the Spuck Foundry Co., J. C. Roller, superintendent of the St. Louis Malleable Castings Co., and Mr. Rook, chemist of the Curtis & Co. Mfg. Co., constitute the committee on by-laws. The proposed trip to Detroit was outlined by E. E. Squier Jr., vice president of the Ed. E. Squier Co., and to his efforts, together with the assistance of C. M. Barker, St. Louis manager of the S. Obermayer Co., the organization of this society is largely due. The members of the St. Louis association will leave that city on Saturday night, June 4, arriving in Chicago the following morning. Their car will be attached to the special train that will carry the Chicago foundrymen to Detroit. Eugene W. Smith, president of the Associated Foundry Foremen, visited St. Louis on April 30 and outlined plans for the organization of this association.

The Exhibits.

A list of the exhibitors, together with descriptions of their displays is given herewith:

ADAMS CO., Dubuque, Ia.—An extensive molding machine exhibit will be made by this concern, consisting of 28 machines, which will be shown in operation. In addition, two grinders, a number of pneumatic rappers, snap flasks, match-plates, flask trimmings, sprue cutters, etc., will also be displayed. Represented by John Nicol, C. Reich, William Spensley and Glenn Muffly.

AMERICAN BLOWER CO., Detroit.—This exhibit will include an electric cupola blower in operation, slow speed exhaust fan, the "Dixie" exhaust fan, the "Sirocco" fan system of heating and ventilating apparatus, an electric lighting set, electric forge blowers, small ventilating sets, etc. Represented by R. T. Coe, M. L. Diver, B. E. LaFollette, A. N. Kelley, W. A. Fletcher and J C. Lewis.

ANTHONY CO.,. New York City.—The fuel oil crucible furnace, built by this concern, for melting non-ferrous metals, will be shown in operation. Represented by A. R. Anthony and John M. Neill.

ARCADE MFG. CO., Freeport, Ill.—The molding machine exhibit that will be made by this concern, will cover 2,600 feet of floor space and will include seven different types of molding machines for producing castings weighing from a few ounces to those weighing 26,000 pounds. A demonstration of pattern plate making will also be made. The machines will all be shown in operation and a crane will be provided for the Norcross jolt ramming machine, to facilitate demonstrating the production of large molds. Represented by E. H. Morgan, Charles Morgan, F. N. Perkins, W. C. Norcross, R. M. Burton, G. D. Wolfley, August Christen, A. Rampenthal and Reeve Burton.

BAIRD & WEST, Detroit.—Detroit Solvay coke will be exhibited by this concern. Represented by Edwin R. Stoughton.

BARTLEY, JONATHAN, CRUCIBLE CO., Trenton, N. J.—All styles of standard crucibles will be shown, together with special crucibles for tilting furnaces, as well as retorts, stoppers, nozzles and all foundry supplies manufactured from graphite. Represented by Jonathan Bartley, T. H. Lawton, S. H. Dougherty and Lee T. Ward.

BAYER PATTERN PLATE & MFG. CO., Cleveland.—This concern will exhibit a large number of composition match-plates, as well as a molding machine of a new type. Represented by Charles W. Brown and Mr. Bayer.

BERKSHIRE MFG. CO., Cleveland.—The Berkshire improved automatic molding machine, a combination hand squeezer and pattern-drawing machine, as well as the Junior squeezer, made by this concern, will be shown in operation. Numerous styles of pattern plates, aluminum, iron and wooden flasks, together with a rotary riddle and sand conveyor will also be exhibited. Represented by R. H. York, J. N. Battenfeld and F C. Battenfeld.

BIRKENSTEIN, S., & SONS, Chicago.—Samples of a complete line of brass founders' alloys, made by this concern, will be exhibited. Represented by J. B. Neiman, E. E. Berliner and Harry Birkenstein.

BROWN SPECIALTY MACHINERY CO., Chicago.—The Hammer core machine, as well as a coning machine, will be shown in operation. Represented by Elmer A. Rich Jr. and John Laycock.

BROWNING, VICTOR R., & CO., Cleveland.—The space occupied by this company will be fitted up with photographs showing foundry installations of conveying machinery, and a hoist and trolley will also be exhibited. Represented by W. D. Browning and H. E. Green.

BUCH'S SONS CO., A., Elizabethtown, Pa.—The molding machines, built by this concern, will be shown in operation, including the portable jar-ramming and squeezer machine, and in addition, a demonstration will be made of a special method of mounting patterns for molding machine use. A special cast iron flask for use on gravity molding machines will be shown, as well as a steel bar for flasks. Represented by R. S. Buch and P. J. Potter.

BUCKEYE PRODUCTS CO., Cincinnati, O.—"Buckeye" and "Okay" parting compounds, "Buckeye" brass flux, core oils, core

Major Joseph T. Speer

Among its members, the American Foundrymen's Association has few more active workers than Major Joseph T. Speer, of Pittsburg. He is now rounding out a term as vice president of this organization and has been the chief executive of the Pittsburg Foundrymen's Association during the past year. He is a practical foundryman of wide experience, and as president of the Pittsburg Valve Foundry & Construction Co., is prominent in the large business affairs of the Smoky City.

Major Speer was born in the fourth ward, Pittsburg, and finished his education in the Western University of Pennsylvania, now the University of Pittsburg. Immediately after leaving school, he entered the employ of Hall & Speer, plow manufacturers, of which firm his father, Alexander Speer, was senior member. After four years' apprenticeship in the pattern shop, he became a journeyman patternmaker and after a four months' trip to Europe, re-entered the employ of this concern and devoted his time entirely to mastering the foundry end of the business. In 1874, the firm name was changed to Alexander Speer & Sons, and William W. Speer became head of the company upon the death of Alexander Speer in 1876.

Hall & Speer were among the pioneer plow manufacturers of the United States, having engaged in this line of foundry work early in the last century. In 1876, Major Speer was sent to South America to establish agencies for the sale of plows in this territory. Headquarters were established at Havana. Major Speer remained from four to six months each year in the tropics and thoroughly familiarized himself with the agricultural resources of this great domain. This Havana agency was maintained until 1896, when the company disposed of its interests in the sale of plows. During his residence in Cuba, Major Speer became known as "Arados Hall," the Spanish term for Hall plow, the trade mark for the brand of plows he sold.

Returning to the United States in 1897, Major Speer succeeded to the management of Alexander Speer & Sons, when his elder brother, William W. Speer, became president of the Dollars Savings Bank, of Pittsburg. He continued in this capacity until November, 1899, when the Pittsburg Valve Foundry & Construction Co. was organized by the consolidation of the firm of Atwood & McCaffery; Shook, Anderson Mfg. Co.; Pittsburg Valve & Machine Co.; the pipe fitting department of Wilson & Snyder, and the foundry department of Alexander Speer & Sons. Henry M. Atwood was president of this company for two years, when the position of chairman of the board of directors was created and Major Speer succeeded to the presidency and active management.

To Major Speer's untiring energy must be credited much of the recent advancement in the production of gray iron and steel castings for high pressure service and he was among the first to use semi-steel in the manufacture of valves.

Major Speer secured his military title through years of service with the Duquesne Grays, having joined this organization as a private in 1874, and continued as a member until after it became a part of the 18th regiment. He was promoted through the various non-commissioned offices, became captain and paymaster of the regimental staff and was later transferred to the 19th regiment in the same capacity. He saw active service during the Pittsburg railroad riots in 1877 and served as a volunteer for three months in the anthracite coal region riots. When the National Guard of Pennsylvania was reorganized, he was made quartermaster of the 18th regiment and was later elected Major. He resigned from the service in 1888. Major Speer was married in 1879 to a daughter of Hon. George Miller, of Virginia. Mrs. Speer died in 1886. Major Speer has traveled extensively, having made trips to Europe in 1872, 1874 and 1878, and had a permanent residence in Munich, Germany, during 1889, 1890 and a part of 1901.

compounds, and a general line of foundry supplies, will be shown. Represented by Charles J. Goehringer and Edward H. Leisl.

BURROUGHS ADDING MACHINE CO., Detroit.—Adding and listing machines will be shown. Represented by F. H. Dodge, F. S. Wheeler and Ward Gavett.

CALUMET ENGINEERING WORKS, Harvey, Ill.—Tumbling wheels, ladles, overhead trolleys and a model of the cupola, built by this concern, will be exhibited. Represented by H. W. Schultze, J. T. Krieger and C. A. Dugan.

CANADIAN MACHINERY, Toronto, Can.

CARBORUNDUM CO., Niagara Falls, N. Y.—This display will include carborundum products, such as grinding wheels, sharpening stones, emery cloth and paper, carborundum cloth and paper, fire sand, etc., as well as carborundum-aloxite wheels. To demonstrate the cutting qualities of carborundum on different kinds of metals, a number of wheels will be shown in operation. Represented by George R. Rayner, C. D. Sargent, F. B. Jacobs, H. A. Eaton and O. C. Dobson.

CENTRAL FOUNDRY SUPPLY CO., Columbus.—This concern will show a complete line of foundry supplies and a feature will be made of "Acme" parting and "Bull Run" talc. Represented by J. S. Ball and William Fenton.

CHICAGO PNEUMATIC TOOL CO., Chicago.—A complete line of pneumatic tools will be shown, including sand rammers, sand sifters, chipping hammers, electric drills and grinders, pneumatic geared wire rope hoists, as well as universal hose couplers. This concern has installed a belt-driven air compressor of the Franklin type, which will supply compressed air for the various exhibits.

CLEVELAND WIRE SPRING CO., Cleveland.—A complete display of shop furniture will be made, including steel tote boxes, steel foundry barrells, steel kegs, steel shelving, etc., as well as sprue boxes, coiled wire springs, etc. Represented by J. W. Campbell, C. H. Erickson, A. S. Chave and J. D. Marshall.

CRESCENT MACHINE CO., Leetonia, O. —The new round jointer head, manufactured by this concern, which is being installed in many pattern shops, will be exhibited. Represented by C. G. Wilderson.

DETROIT FOUNDRY SUPPLY CO., Detroit.—An extensive exhibit of foundry supplies and equipment will be made, including core ovens, brass furnaces, oil burners, glue heaters, roll-over molding machines, shovels, crucibles, adjustable clamps, aluminum snap flasks, blow torches, riddles, etc. The supplies and equipment for platers will include chemicals, plating dynamos, buffing wheels and nickeled work from various stove plants, and valves and other castings which have been buffed with the tripoli made by this concern will also be exhibited. Represented by Edward J. Woodison, W. B. Howard, W. H. Case, W. H. Fitzpatrick, J. C. Dissette, W. W. Murray, C. D. Yahne and George L. Grimes.

DETROIT TESTING LABORATORY, Detroit.—Photo-micrographs of metals, combustion and recalescence electric furnaces, as well as charts, showing the results of chemical and physical tests of metals, will be displayed. Represented by W. P. Putnam, J. D. Stoddard and Hugh Lamont.

DIXON, JOSEPH, CRUCIBLE CO., Jersey City, N. J.—The exhibit of this concern will include a display of crucibles, stoppers, nozzles, sleeves, mufflers, skimmers, stirrers, retorts, graphite bricks, special crucibles for patent furnaces, foundry facings and motor brushes. Representatives from the various branch offices will be in attendance and regardless of what section of the country a foundryman may hail from, he will meet a representative of this concern with whom he is acquainted, at the Dixon booth.

DOGGETT, STANLEY, New York City.—Parting compounds and facings will be shown, including lead and soapstone facings, and a new product, known as "Faceamold." Represented by Stanley Doggett, William Busser and W. S. Rupert.

FALLS RIVER & MACHINE CO., Cuyahoga Falls, O.—This space will be fitted up as a modern core room and will include a Wadsworth improved coremaking machine, core oven, core cutting-off and coning machine, standard core prints, steel core rack, sand mixing and compounding mill and the new Wadsworth, vertical, jar-ramming, core-forming machine. Represented by George H. Wadsworth and George White.

FEDERAL FOUNDRY SUPPLY CO., Cleveland. — Two jar-ramming, stripping and roll-over machines, especially adapted for making automobile parts, will be shown in operation in the space of this concern. In addition, samples of plumbago, Bright's dry core compound, stove plate facing, ventless facing, etc., will be displayed. Represented by Ralph Ditty, W. J. Adams and W. R. Beers.

THE FOUNDRY, Cleveland.—The silver loving cups, which will be awarded for the best still and operating exhibits, will be displayed in this booth.

FOUNDRY NEWS, New York City.

FOUNDRY SPECIALTY CO., Cincinnati. —A demonstration will be made of the use of "Partine," a parting compound, and brass fluxes and other specialties will be shown. Represented by F. W. Weissman.

GARDNER PRINTING CO., Cleveland.

GOLDSCHMIDT THERMIT CO., New York City.—Demonstrations of the use of Thermit will be made, which is used extensively in foundries for the purpose of reviving dull iron in the ladle, in the production of semi-steel and for keeping risers liquid. Titanium steel, made for purifying molten iron and steel, will also be shown. A demonstration will be made of the Thermit process of repairing small defects in castings and for welding large wrought iron and steel sections. Numerous specimens of Thermit welds will be on exhibition and samples of pure chromium, manganese, ferro-titanium, etc., will also be shown. Represented by H. S. Mann and J. G. McCarty.

HANNA ENGINEERING WORKS, Chicago.—An extensive exhibit will be made by this concern, including the Rathbone multiple molding machine, electric revolving dumping riddle, electric rocking riddle, small and large tripod pneumatic shakers, pneumatic post shaker, mold dryer, pneumatic sand blast shaker, compression yoke riveter and a pinch-bug riveter. Represented by James T. Lee.

HAUCK MFG. CO., Brooklyn.—The following equipment, manufactured by this concern, will be shown in operation: Portable burners and heaters for lighting cupolas, skin drying molds, burning on castings, annealing, etc., kerosene torches, rivet, brazing and blacksmith forges. Represented by Arthur E. Hauck.

HAWLEY DOWN DRAFT FURNACE CO., Chicago.—The Schwartz furnace, the Reyelbec coke furnace and a fuel oil crucible furnace will be shown. Represented by Cliff M. Bleyer, Harry Stow, D. J. O'Brien and Frank Rolff.

HERMAN PNEUMATIC MACHINE CO., Pittsburg.—Jarring machines will be shown in operation, including one machine equipped with a table 60 inches square for making large molds, and another with a table 30 x 45 inches, fitted with a roll-over and pattern-drawing device. A jar-ramming stripping plate machine with a table, 24 x 30 inches, will also be exhibited as well as a combination jar-ramming and a squeezer machine with a table plate, 16 x 18 inches. Represented by Martin L. Heyl, Charles Herman, Alfred Herman, H. T. Frauenheim, Joseph H. Bialas and John J. Lawlor.

HICKMAN, WILLIAMS & CO., Chicago. —Samples of pig iron will be shown in the space reserved by this concern, which will be fitted up as an office. Represented by H. E. Pierce, S. E. Frazee, B. P. Williams, E. P. Hettiger, Richmond Nicholas, H. Black, R. B. Miller, John Daker Jr., John U. Byrd, T. L. Powell, L. E. Patton, T. C. Ward, T. A. Arthur, W. L. Hoffman, J. B. Holloway, Day Williams, R. W. Kellow, C. A. Reed and L. H. Miller.

HIGH PRESSURE SAND BLAST CO., New York City.—The Kelly sand blast machine, built by this concern, will be shown. Represented by C. W. McLane and Arthur E. Lee.

HILL & GRIFFITH CO., Cincinnati.—Samples of a complete line of foundry sup-

Condensed Convention Program

Monday, June 6, 10 a. m.

Opening of the exposition of foundry supplies and equipment, held under the auspices of the Foundry and Manufacturers' Supply Association at the Michigan State Fair grounds.

Monday Evening.

Dinner at the Hotel Pontchartrain, tendered by the Detroit Foundrymen's Association to the officers of the allied organizations.

Tuesday, June 7, 10 a. m.

Opening session of the American Foundrymen's Association and the American Brass Founders' Association in the Michigan State Building at the Fair grounds.

Tuesday, 2 p. m.

Professional sessions of the American Foundrymen's Association and the American Brass Founders' Association.

Tuesday Evening.

Smoker at the Light Guard Armory.

Theater party for the ladies at the Temple theater.

Wednesday, June 8, 10 a. m.

Professional sessions of the American Foundrymen's Association and the American Brass Founders' Association.

Wednesday Afternoon and Evening.

Boat ride on the Detroit river.

Thursday, June 9, 10 a. m.

Professional sessions of the American Foundrymen's Association and the American Brass Founders' Association.

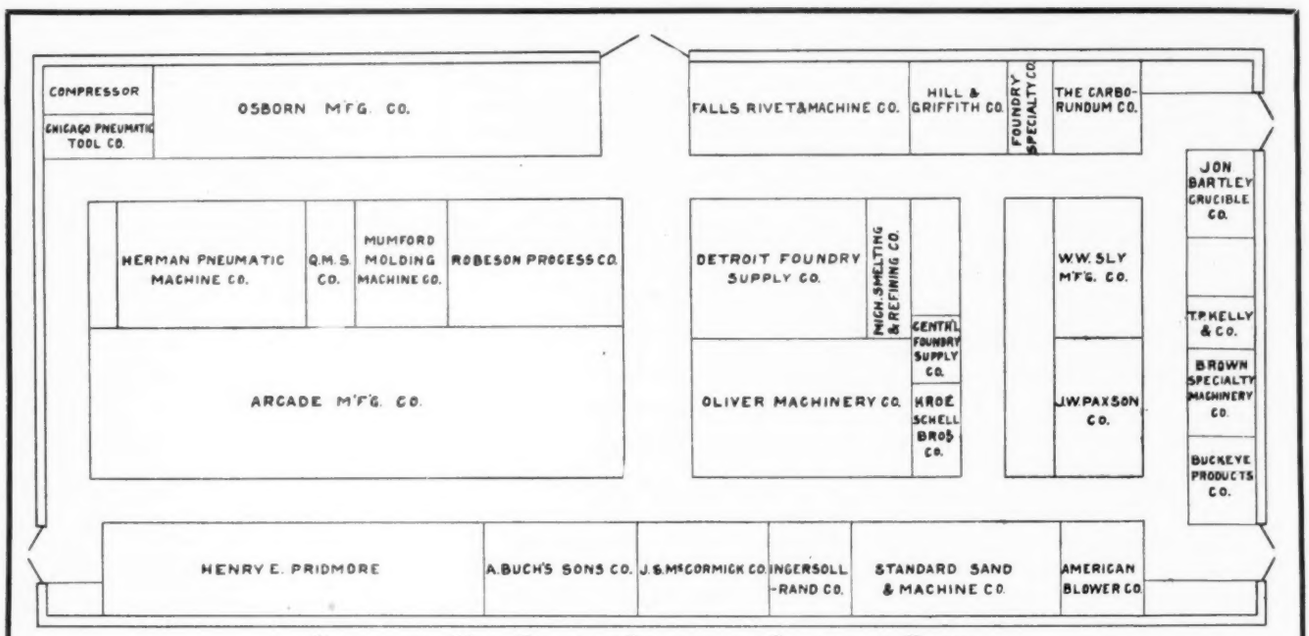
Thursday, 2 p. m.

Professional sessions of the American Foundrymen's Association and the American Brass Founders' Association.

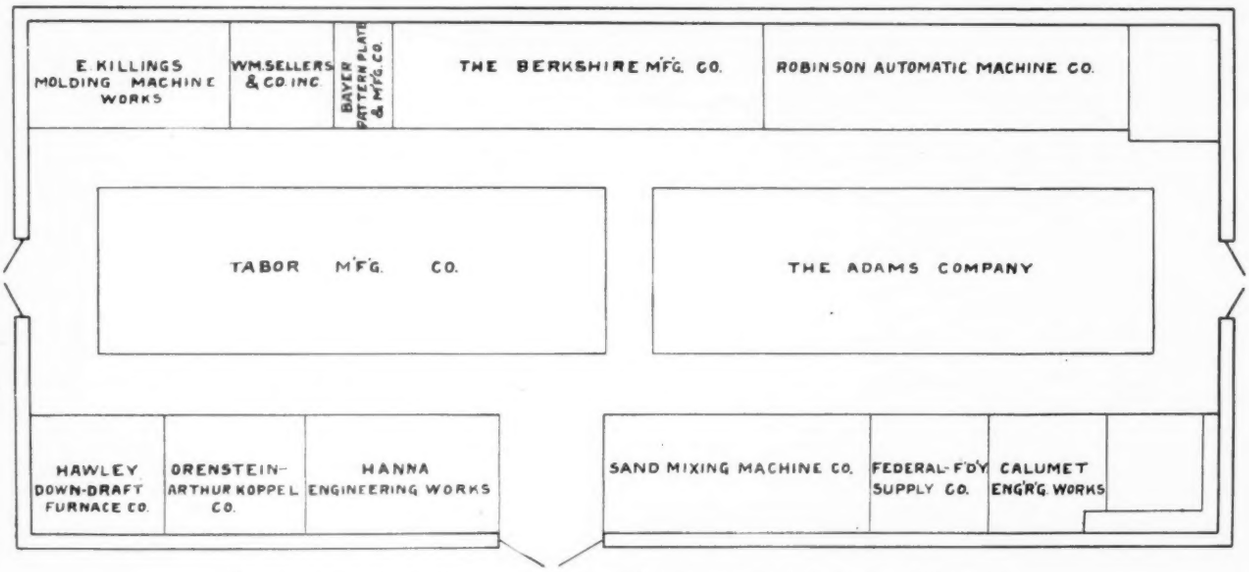
Automobile trip for the ladies.

Friday, 10 a. m.

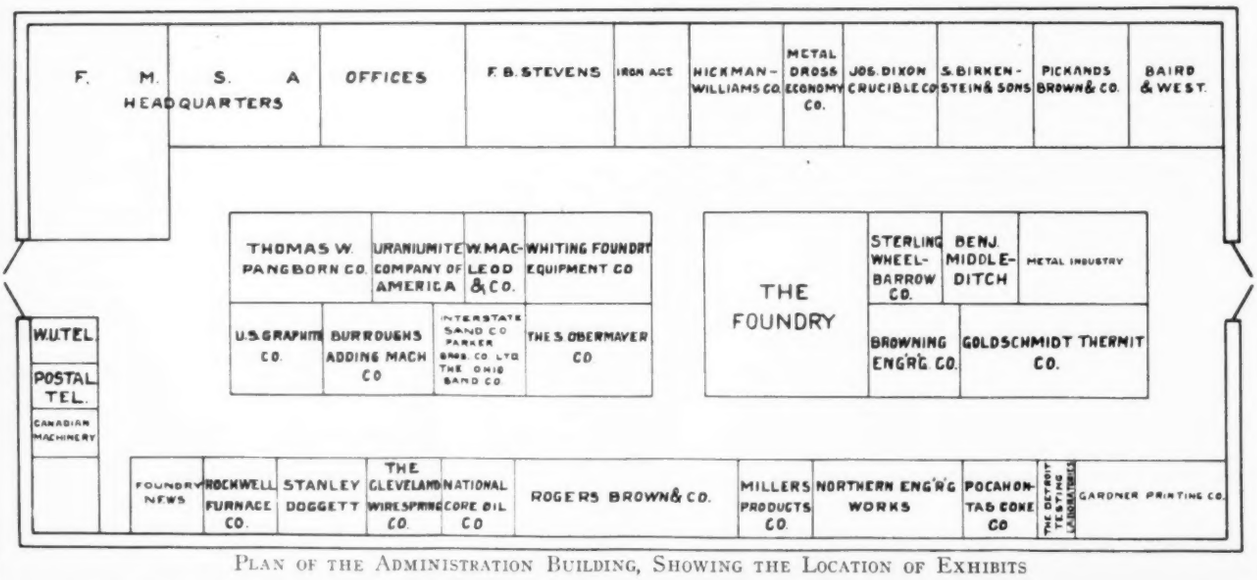
Closing session of the American Foundrymen's Association.



PLAN OF THE MAIN BUILDING, SHOWING THE LOCATION OF EXHIBITS



PLAN OF THE HORTICULTURAL BUILDING, SHOWING THE LOCATION OF EXHIBITS



PLAN OF THE ADMINISTRATION BUILDING, SHOWING THE LOCATION OF EXHIBITS

plies will be shown by this concern, as well as a number of specialties, including Haskins' ventilated chaplets, perforated chaplets, tamping head molders' shovels, parting compounds, molders' bellows, brushes, etc. A rest room will also be provided for visiting foundrymen. Represented by J. M. Glass, John Hill and M. Z. Fox.

INGERSOLL-RAND CO., New York City.—This exhibit will include a motor-driven, dust-proof compressor of the high speed type, pneumatic sand rammers for floor and bench use, pneumatic chipping hammers and drills, pneumatic motor hoists and a stationary air motor. In addition, sectional models of various pneumatic tools for foundry use will be shown. Represented by W. H. Armstrong, James Moran, W. A. Armstrong and James L. Kelly.

INTERSTATE SAND CO., Zanesville, O.—Samples of various grades of molding sands for iron, steel and brass foundry use. Represented by U. E. Kanavel, E. M. Ayers, L. K. Brown and R. S. Wilson.

IRON AGE, New York City.

KELLY, T. P., & CO., New York City.—The booth of this concern will be fitted up as an office. Represented by T. P. Kelly, Edwin R. Wolverton and John S. Crowley.

KILLING'S, E., MOLDING MACHINE WORKS, Davenport, Ia.—A complete line of molding machines, made by this concern, will be shown, including an automatic Duplex power squeezer, Universal jarring machine, Universal roll-over, straight drop molding machine, combination foot-jarring rock-over machine for deep draws, stripping plate machine and a pneumatic sand sifter. Represented by Ewald Killing, C. P. Aabye, William White and A. W. Fox.

KROESCHELL BROS. CO., Chicago.—This exhibit will include a complete line of Kroeschell-Schwartz gyrating flame crucible furnaces of the tilting and stationary types, ladle heater, mold drier, etc. This equipment will be complete in every detail and will be connected with a positive pressure blower and an oil pumping and circulating system. Represented by W. L. Kroeschell and E. H. Schwartz.

McCORMICK, J. S., CO., Pittsburg.—The McCormick continuous sand mixer, Blake wire straightener, and wire cutter, Deane pneumatic sand riddle, 20th Century pneumatic molding machine, as well as a complete line of foundry supplies, will be shown. Represented by J. S. McCormick, T. E. Malone and S. R. Costley.

MACLEOD, WALTER, & CO., Cincinnati.—This exhibit will include a complete line of portable heaters, blacking sprayers and sand blast machines. The exhibit will be in charge of representatives of the S. Obermayer Co.

METAL DROSS ECONOMY CO., Bristol, Conn.—The skimming device, manufactured by this company for brass foundry use, will be shown. Represented by A. L. Haasis and W. H. Carpenter.

METAL INDUSTRY, New York City.

MICHIGAN SMELTING & REFINING CO., Detroit.—This exhibit will consist of yellow and red brass ingots with sample castings made from these alloys. Solders, babbitt metals, and a number of new non-ferrous alloys, will also be shown. Represented by Joseph Sillman, Albert J. Hall, T. R. McNamee, S. R. Gingsburg and H. Levitt.

MIDDLEDITCH, BENJAMIN, Detroit.—The exhibit of this concern will include foot and power sprue cutters, tumbling barrel, polishing machine and flasks for use in brass, bronze and aluminum foundries. Represented by Benjamin Middleditch, Samuel A. Laffrey and Peter de Vries.

MILLERS' PRODUCTS CO., Chicago.—Various samples of foundry flour and core compounds will be shown. Represented by C. B. Spaulding and W. M. Wilson.

MONARCH ENGINEERING & MFG. CO., Baltimore, Md.—The complete line of furnaces, made by this concern, will be shown in operation. These are adapted for the use of oil or gas as fuel, and for melting ferrous and non-ferrous metals, as well as for heating. In addition, core ovens, steel foundry ladles, heating equipment, aluminum furnaces, bolt heating furnaces, blowers, etc., will be shown in operation. Represented by David R. Steele, H. D. Harvey, W. W. Woodburn, James H. Fowler and James J. Allen.

MUMFORD MOLDING MACHINE CO., New York City.—All of the molding machines shown by this concern will be operated, and will include a 12-inch plain power squeezer with match-plate and vibrator; 10-inch high trunnion squeezer; 13 x 18-inch power ramming, split pattern vibrator machine; plain jolt-ramming machine; one set of match-plate steady pin pattern guides and a jib molder for bench work, containing a match-plate holder, interchangeable snap flask, mold roll-over, simultaneous cope and drag pattern draft, mold closer and flask opener. The latter machine is auxiliary to the plain squeezer, and rolls the mold, draws cope and drag patterns simultaneously, closes the mold and opens the snap flask. The match-plate steady pin pattern guide will be shown in operation on wooden match-boards in connection with molds rammed on a 10-inch jolt-ramming machine, which will be lifted and rolled with pattern draft by the Q M S Co.'s pneumatic hoist. Represented by E. H. Mumford, F. W. Hamel and A. J. Goss.

NATIONAL CORE OIL CO., Corning, N. Y.—An extensive exhibit of cores, made with the core oil manufactured by this concern, as a binder, will be shown. Represented by C. H. Cotton, L. C. Allen and P. L. Crandall.

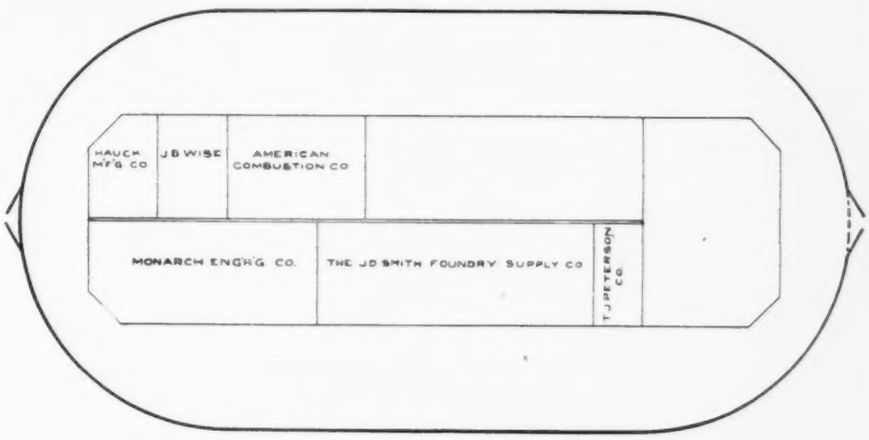
NORTHERN ENGINEERING WORKS, Detroit.—A Newten cupola will be shown by this concern, as well as a working model of a traveling crane trolley, overhead tramway and trolley, crane ladles, electric and air hoists and photographs of electric cranes and miscellaneous foundry equipment, including turntables for surface tramways, will also be displayed. In the exhibit of the Arcade Mfg. Co., the Northern Engineering Works will install an alternating current electric traveling crane with a hand power bridge and electric hoist. This will be used to handle the large molds made on the jolt-ramming machines in this exhibit. Represented by W. G. Chesebrough, Walter Robinson, E. S. Reid, G. A. True and H. W. Standart.

OBERMAYER, S., CO., Cincinnati.—This booth will be fitted up as a rest room, where the foundrymen can meet their friends. No display of foundry supplies or equipment will be made. Represented by H. F. Frohman, Justus Thorner, S. T. Johnston, F. W. Dodge, Fred J. Brunner, Harry Wessling, William Fitzpatrick, James E. Evans, J. McDevitt and O. Peterson.

OHIO SAND CO., Conneaut, O.—Samples of various grades of molding sands for iron, steel and brass foundry use will be displayed. Represented by F. E. Gordon and Arthur S. Barrows.

OLIVER MACHINERY CO., Grand Rapids, Mich.—A complete line of patternmaking machinery will be exhibited, including a speed lathe, hand jointer, surface table, wood trimmer, surfacer, band sawing machine, wood lathe, boring machine, saw benches and a wood milling machine. Represented by J. W. Oliver, A. N. Spencer, W. Y. Mentzer and J. P. Schmidt.

OSBORN MFG. CO., Cleveland.—This concern will have an extensive operating exhibit of molding machines, consisting of plain and rock-over jolt molding machines, hand rock-over machines, a new type of hand roll-over machine, as well as a complete line of flask stripping and stripping plate molding machines. In addition, a line of general foundry supplies will be exhibited, including wire wheel brushes, riddles, bellows, and the Rice patent bridle casting brushes. Represented by H. R. Atwater, F. D. Jacobs, E. T. Doddridge, J. C. Boyton and J. H. Galloway.



PLAN OF THE TENT, SHOWING THE LOCATION OF EXHIBITS

PANGBORN, THOMAS W., CO., New York City.—The exhibit of this concern will consist of high pressure sand blast systems, sand separating systems, sand driers and air separators. Represented by John C. Pangborn, Harry D. Gates, Jesse J. Bowen, Willis S. Doane, Alfred L. Homans, Raymond F. Smith and Foster J. Hull.

PARKER BROS. CO., LTD., Detroit.—Samples of various grades of molding sands for iron, steel and brass foundry use will be exhibited. Represented by W. R. Thompson.

PAXSON, J. W., CO., Philadelphia.—A number of molding machines will be shown in operation, including the Barker rock-over, pattern-drawing machine, magnetic separators, overhead tramrails and tripod sifters. A complete line of samples of all supplies used in the foundry will be exhibited, and drawings and photographs of equipment will be displayed. Represented by H. M. Bougher, George W.

Moore, A. W. Moyer, I. F. Kremer, W. Scott Thomas, W. T. Nicholson and W. Beatty.

PETERSON, T. J., CO., Chicago.—Samples of core oils, made by this concern, will be exhibited.

PICKANDS, BROWN & CO., Chicago.—This booth will be enclosed by a wall of Solvay coke, a large arched entrance being constructed in the center, with smaller arches on either side. In the latter will be displayed various sizes of crushed coke used in brass foundries, blacksmith shops, etc. Represented by B. T. Bacon, George A. T. Long, James A. Galligan and Thomas Glasscot.

PRIDMORE, HENRY E., Chicago.—An extensive exhibit of molding machines, in operation, will be made. The display will include four small, square stand stripping plate machines, including patterns, one large, square, heavy double shaft stripping plate machine, including patterns, one stove plate rock-over machine, four rock-over drop machines, fitted with automobile patterns, one 12 x 18-inch power ramming rock-over drop molding machine and one special core molding machine. Represented by Edward A. Pridmore, R. E. Turnbull, D. F. Eagan and W. W. Miller.

Q M S CO., Plainfield, N. J.—This exhibit will include steel foundry saws, motor-driven, fitted with Disston inserted tooth blades, hand power traveling crane, trolleys and air hoists. Represented by R. H. Post and F. R. Phillips.

RANDALL TRAMRAIL CO., Philadelphia.—The Randall Tramrail system, showing a safety switch, cross-over, scales and turntable, will be displayed, as well as the Randall roller bearing trolleys. Represented by Frederick L. Smith.

ROBESON PROCESS CO., Au Sable Forks, N. Y.—"Glutrin," the liquid core binder, made by this concern, will be exhibited. Represented by D. S. Robeson, Henry R. Donald and Martin Pierce.

ROBINSON AUTOMATIC MACHINE CO., Detroit.—One ten-arm automatic polishing machine will be shown in operation. This type is especially adapted for polishing flat and oval castings such as stove plate and other similar sections. Represented by C. F. Coda and Charles Mear.

ROCKWELL FURNACE CO., New York City.—Photographs of melting furnace equipment, manufactured by this concern, will be displayed. Represented by W. S. Quigley and A. L. Stevens.

ROGERS, BROWN & CO., Cincinnati.—This concern will make an exceedingly interesting display, as the entire back of its space will be taken up by a large map, showing the greater portion of the United States and a part of Canada, giving the location of the blast furnaces in which the company is interested and represents. Each of the furnaces will be shown by a red light, the company's ten offices by white lights, and the various coke regions by blue lights. An interesting display of samples of pig iron manufactured in China, Germany, Scotland, England, Sweden and Dominion of Canada, all of which were imported by this house during the past year, will be made. The rail in front of the exhibit will consist of pigs of iron cast at the company's Detroit furnace, and the caps of the four posts will consist of car wheels cast by the American Car & Foundry Co., in which a large amount of this Detroit iron was used. A number of interesting castings will also be shown, made from special irons, and samples of fluorspar are to be exhibited. Represented by H. B. B. Yergason.

SAND MIXING MACHINE CO., New York City.—The Auto sand mixer, built by this concern, used for cutting molding sand and for mixing core and facing sand, will be shown in operation. Represented by V. E. Minich and B. L. Doup.

SELLERS, WM., & CO., INC., Philadelphia.—Centrifugal sand mixing machines and a drill grinding machine will be shown in operation. Represented by Edward L. Holljes.

SLY, W. W., MFG. CO., Cleveland.—Complete cleaning room equipment in miniature will be shown, consisting of round and square exhaust cleaning mills, an iron cinder mill, dust arrester and exhaust fan. Represented by W. W. Sly, W. C. Sly, H. R. Morse and H. J. Norris.

SMITH, J. D., FOUNDRY SUPPLY CO., Cleveland.—Core ovens, brass melting furnaces, sprue cutters, tumbling mills, molding machines, core sand mixers, and a sand blast will be shown by this concern. Represented by P. G. Smith, J. S. Smith, Joseph Harrison, M. S. Finley and F. A. Coleman.

STANDARD SAND & MACHINE CO., Cleveland.—A complete line of sand mixing and handling machines will be shown in operation, including a centrifugal pulverizer and disintegrating machine, a batch mixer, rolling and blending machine, a large proportioning, screening, mixing, tempering and blending machine and an adjustable power screen will also be displayed. Represented by J. A. Boughton, H. E. Boughton, E. J. Smith and T. J. Morgan.

STERLING WHEELBARROW CO., Milwaukee.—A complete line of rolled steel flasks, manufactured by this concern, will be shown. Represented by I. R. Smith and H. G. Mindrum.

STEVENS, FREDERIC B., Detroit.—Foundry supplies, including facings, etc., as well as platers' supplies, such as buffing compositions, foundry and buffing machinery, etc., will be displayed. Represented by Frederic B. Stevens.

TABOR MFG. CO., Philadelphia.—This concern will exhibit its standard power-squeezing molding machines, roll-over machines, operated by hand and by power, shockless jarring machines, combination jarring and roll-over machines and combination jarring and squeezing roll-over machines. These will be set on the exhibition floor so that the entire mechanism will be in plain view and raised platforms will be built to show the proper floor level. Represented by Wilfred Lewis, John T. Ramsden, C. W. Coleman, C. H. Ellis, J. H. Coleman and the demonstrators will be H. W. Impey, Dudley Wilcox and J. Pfender.

UNITED STATES GRAPHITE CO., Saginaw, Mich.—This concern will not have an exhibit, but will maintain a booth in the administration building. Represented by H. C. Woodruff, Frank B. Godard, R. A. Corrigan and J. G. Drought.

URANIUMITE COMPANY OF AMERICA, Buffalo.—Samples of "Uraniumite," together with castings, both ferrous and nonferrous, containing "Uraniumite," will be exhibited. Represented by Dr. William L. Bechtold and John H. Smith.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill.—In the booth of this concern a large number of photographs of foundry equipment will be displayed. Represented by C. A. Hardy, P. A. Dratz, R. H. Bourne, C. Hughes, T. S. Hammond and F. A. Rundle.

WISE, J. B., Watertown, N. Y.—The M. R. V. furnace, which is of the tilting type, using coke as fuel, will be shown in operation. Represented by J. B. Wise.

ANNUAL MEETINGS OF STOVE MANUFACTURERS.

The Stove Founders' National Defense Association and the National Association of Stove Manufacturers held their annual conventions, May 11 to 13, in the Hotel Astor, New York City. The Stove Founders' National Defense Association met May 11. William H. Cribben, Chicago, who has been president several years, refused re-election, and the honor was bestowed upon George Mitchell, Pittston, Pa. The other officers elected are as follows: Vice presidents, Frederick Will, Rochester, N. Y., and Lee W. Van Cleave, St. Louis; treasurer, William A. Dwyer, Detroit; secretary, Thomas J. Hogan, Chicago. The district committees remain unchanged, and are as follows: First district, E. W. Anthony and A. W. Walker, Boston; O. G. Thomas, J. L. Anthony and H. A. Tinkham, Taunton. Second district, E. W. Peck, Rochester, N. Y.; R. G. Rennolas, Richmond, Va.; W. D. Snyder, Columbia, Pa.; J. A. Lansing, Scranton, Pa.; E. Benedict, New York City. Third district, Stanhope Boal, Piqua, O.; George H. Barbour, Detroit; S. Kahn, Hamilton, O.; William A. Dwyer, Detroit; H. J. Karges, Evansville, Ind. Fourth district, Ralph S. Buck, St. Louis; N. H. Burt, Leavenworth, Kans.; H. A. Viets, Milwaukee; J. W. Emery, Quincy, Ill., and Fred Satler, Belleville, Ill.

The National Association of Stove Manufacturers held its annual meeting, May 12 and 13. A large number of interesting papers were read and a number of live topics discussed. The officers of the association were re-elected as follows: President, William J. Meyers, New York; vice presidents, Abram C. Mott, Philadelphia, and Joseph W. Emery, Quincy, Ill.; treasurer, T. Darl Buckwalter, Royersford, Pa.; secretary, Edward C. Hanrahan, Chicago.

WHITE METAL MIXTURES.

Question:—We would like to have a white metal mixture for castings weighing from one to five pounds.

Answer:—A good white metal mixture for this purpose consists of lead, 80 per cent; tin, 10 per cent; and antimony, 10 per cent. Another mixture follows: Tin, 87 per cent; antimony, 10 per cent; copper, 3 per cent.

The branch warehouse of the J. W. Paxson Co., Philadelphia, 36 Exchange Place, Providence, R. I., carries a complete line of foundry supplies and equipment, for immediate shipment to plants located in the New England district. This warehouse is under the management of W. T. Nicholson and his son, W. T. Nicholson Jr.

FORMULAS FOR THE BRASS FOUNDRYMAN.

Copper Castings for Electrical Purposes.

It is important that copper castings used for switchboards, cable connectors, terminal lugs and other electrical work shall be as nearly pure copper as possible, in order that their electrical efficiency will be high. Absolutely pure copper cannot be cast, as it absorbs gases while being melted which cause the castings to be full of holes, or honeycombed. It is, therefore, necessary to add some element to the molten copper which will eliminate the gases and produce solid castings, and in ordinary casting copper, zinc produces the best results, but so much of it must be used that the metal is very little higher in conductivity than bronze. The copper must also cast well, and produce clean solid castings, and while magnesium gives the highest conductivity, silicon produces the cleanest and most reliable castings. The following mixture is therefore recommended:

Copper	100 pounds.
Ten per cent silicon-copper	12 ounces.

The tensile strength of this copper is 23,000 pounds per square inch, and the conductivity is high.

In order to obtain good results with such a small percentage of silicon, the copper must be very carefully melted. The ingots should be so placed in the crucible, that they do not extend over the top, and two tablespoonfuls of salt is added with the ingots, several pieces of charcoal being placed on top when the metal begins to sink down and before it melts. The other ingots to be melted should be placed on top of the pot until they become red hot, when they can be removed with the tongs and pushed into the molten metal, charcoal also being added from time to time, as required, to keep the metal covered. When all of the metal is melted in this manner its surface will be seen to be limpid beneath the charcoal. The silicon-copper, may now be added, having been previously warmed, and the contents of the crucible should be vigorously stirred with a plumbago stirrer. The metal should then be superheated ten minutes, and poured into the molds quite hot. Bottom-pour crucibles are best for this class of work, as they obviate the necessity of contaminating the metal with an iron skimmer.

DATA SHEET No. 67, THE FOUNDRY, JUNE, 1910.

FORMULAS FOR THE BRASS FOUNDRYMAN.

Ounce Metal.

Ounce metal derives its name from the fact that one ounce each of the white metals is added to one pound of copper. It is an excellent formula for steam goods that are not subjected to high pressures, and is extensively used for general castings. The formula follows:

Copper	80
Tin	5
Zinc	5
Lead	5

First melt the copper, using charcoal and salt, and, when liquid and clear add the zinc, which should have been previously warmed. Push it under the charcoal and stir vigorously. Add the tin next, and lastly the lead, again stirring.

No specific directions can be given regarding the proper pouring temperature, as that will vary greatly with the character of the work, some castings requiring hot metal, and others comparatively cool.

When ounce metal is made harder by doubling the quantity of tin, it is largely known by the trade name of Key metal. The formula then becomes:

Copper	80
Tin	10
Zinc	5
Lead	5

Key metal is used whenever a hard metal is desired, and it derives its name from being used in making the old-fashioned heavy door keys, because it is sufficiently stiff not to bend, runs fluid and files well.

It will be found useful for machinery castings when a stiff, hard metal is desirable.

DATA SHEET No. 68, THE FOUNDRY, JUNE, 1910.

Note.—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, JUNE, 1910.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

THE BRASS FOUNDRY

The World's Largest Aluminum Foundry

DETROIT, which is rapidly forging to the front as one of the leading foundry centers of the United States, is now the home of a plant conceded to be the largest foundry in the country, if not in the world, devoted to the production of aluminum castings exclusively. To keep pace with the constantly growing requirements of the automobile industry, and with a view to ultimately centralizing the aluminum business of its three Detroit plants on one site, the Aluminum Castings Co., Cleveland, about a year ago purchased a tract of 26 acres in the City of the Straits, upon which the new foundry was erected.

Layout of the Shop.

The layout of the shop is unique, in that it is arranged on the unit system, each unit being practically a detached foundry, provided with its own core room and melting department. The advantages of this arrangement far outweigh any objections that might be advanced against this type of construction and method of operation. The entire plant is in charge of a superintendent, to whom the foremen of the various units are responsible. The competition among the foremen of each unit will naturally lead to the further development of labor-saving methods and appliances, which can be adapted advantageously in the other units. Furthermore, this system permits of the classification of work in a way that has not been found possible in shops where light and heavy, and small and large work must be assigned to one molding floor. By assigning the light work to one unit, and the heavy work to another, the men become more proficient, and operating costs are proportionately curtailed. An opportunity is also afforded for comparing the methods of the different units on work of a similar nature, and in this way the lowest basis of the cost of production can be attained. During periods of limited demand, the unit plan of operation permits of the shutting down of any number of departments, thereby eliminating a large portion of the expense entailed in operating a large foundry on a limited output.

Transportation Facilities.

This plant consists of ten units, five of which have been completed and were recently placed in operation. Further extensions may be made without disturbing the general layout, and the foundries that will be built to meet the needs of the growing business of this concern will parallel and adjoin the existing units. A plan view of the five completed units is shown in Fig. 13, and interior views of two of these foundries are

FIG. 1—A VIEW OF ONE OF THE FOUNDRY UNITS IN WHICH A LARGE NUMBER OF MOLDING MACHINES HAVE BEEN INSTALLED

illustrated in Figs. 1 and 11. The entire plant, ten units, is 600 x 264 feet, and each unit is 60 feet wide. The melting furnaces are located in two lean-tos, 20 feet wide and 86 feet long, which are divided from each unit by a brick wall, making each melting department approximately 40 feet long. Extending through the center of each foundry is an industrial track which leads to a wide passageway running the length of the plant and at right angles to the foundries and the core departments. A narrow gage track is laid through the center of this passage, which communicates with the tracks in each of the units. This industrial railway system affords excellent transportation facilities throughout the plant, and is used for delivering sand, flasks and patterns to the various foundries, and for the shipment of the castings from these units to the cleaning department. This passage way also serves to separate the core rooms from the foundry units.

Grinding and Shipping Department.

The grinding and shipping departments are located in unit No. 1, and in the core room end are the pattern and machine shops. A view of the grinding and chipping shop is shown in Fig. 4. It will be noted that the chipping is all done on one side of the shop, the pneumatic chippers taking their air from an overhead line extending the length of the building. On the opposite side is a band saw, installed by the Crescent Machine Co., Leetonia, O. For cutting off gates, two motor-driven grinders are provided, furnished by the Bridgeport Safety Emery Wheel Co., Bridgeport, Conn. The castings, after the removal of the cores, are delivered to this department on cars operating over the industrial track system previously described.

Extensions.

In the first ten units aluminum will be cast exclusively, and in the additional sections, to be added later, the three Detroit brass foundries operated by this concern will finally be consolidated. The cleaning rooms for these foundries will occupy a portion of the space set apart for the core rooms. In this way the gates and sprues, as well as the grindings of each unit will be kept separate, a very desirable arrangement in brass foundry operation, which will obviate the mixing of the scrap from the various units. The sand-preparing plant for the entire foundry is located in a basement extending partially under unit No. 1, the mixing machinery being located in the basement underneath the pattern shop. A chute, covered with a grating, leads from the chipping department to the sand-preparing plant, and castings reaching the shipping department without the cores removed will be shaken out over the grating. The sand receiving track parallels the core room side of the foundry and the sand is unloaded from cars into chutes leading into the basement.

Core Departments.

Each core room is provided with four ovens, which are located so as to divide the core departments into separate units. The ovens are located side by side, with alternate openings into the two core rooms, which they separate from each other. This arrangement is clearly shown in Fig. 3, a view of one side of one of the core shops. Tracks are laid into each oven, which have a capacity of one car each, and two rows of shelves are located on either side of each oven, for small cores. The oven doors are counterweighted and can be easily raised or lowered, sliding in the guides shown. The ovens are oil-fired and the fuel cost averages only from 7 to 10 cents per night for each oven. The white appearance of the cores is due to the core wash used, with which all of the cores are sprayed in place of coating them with plumbago. This gives the cored surface of the castings a very smooth finish, which is essential

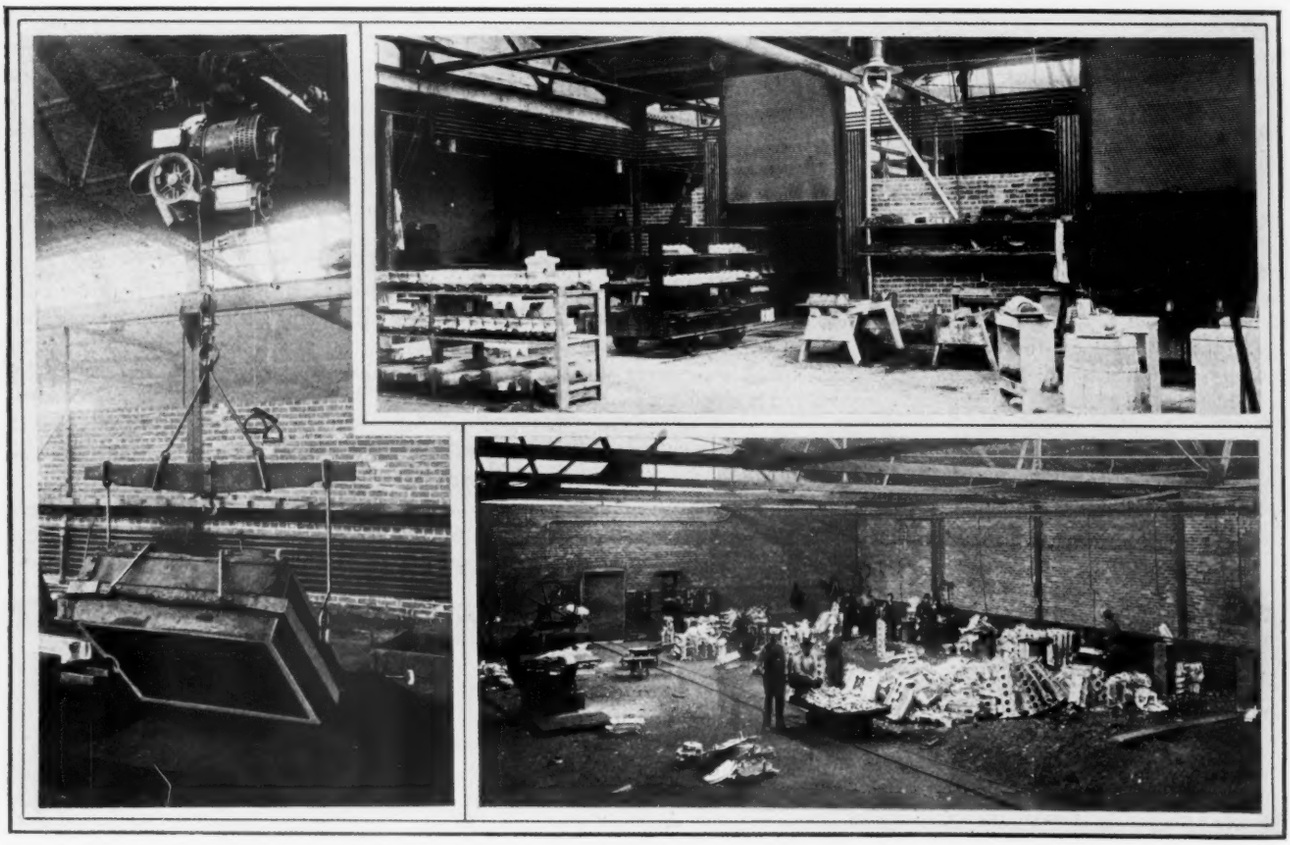


FIG. 2—ELECTRIC HOIST USED FOR HANDLING LARGE MOLDS

FIG. 3—A VIEW OF ONE OF THE CORE DEPARTMENTS, SHOWING THE CORE OVENS
FIG. 4—THE CHIPPING AND GRINDING DEPARTMENT

in aluminum work. The coremakers' benches extend along the ends of the rooms as well as at the sides. When the plant was designed, guided by previous experience, it was decided to devote 40 per cent of the plant area to the core departments.

Electric Hoists.

Each foundry is commanded by two electric traveling cranes, each spanning the width of one-half of the shop. The cranes already installed were furnished by the Brown Hoisting Machinery Co., Cleveland, and the floor-controlled electric hoist with which the cranes are equipped, by the Yale & Towne Mfg. Co., New York City. One of these hoists, rolling over a large flask, is shown in Fig. 2. The crane runways at one end are supported from the roof trusses in the center of the foundry, this construction eliminating all obstructions on the foundry floors.

Two 1½-ton electric traveling cranes, Fig. 15, have already been installed in one unit. The crane bridge consists of a 12-inch, 31½-pound I-beam, reinforced by an 8-inch, 11¼-pound channel. It is driven by a one-horsepower motor, giving a traveling speed of 150 feet per minute with full load. The trolley is provided with wheels of ample diameter, having axles supported at each end, operating in bronze bearings. The trolley is driven across the bridge by a pendant hand chain, requiring a pull of only 24 pounds to move the fully loaded trolley. It is equipped with current collectors for taking current from cross-bridge feed wires and supplying this current to the electric hoist. The Yale & Towne hoist has a three-horsepower motor, giving a speed of 20 feet per minute under full load. It is controlled from the floor by pendant cords, enabling the operator to carefully watch his work, and by means of the graduated speed controller, to raise or lower the molds at any desired speed.

The melting departments for each foundry are located in lean-tos on the end of the plant, opposite the core room. Two of these departments are shown in Figs. 5 and 7. They are equipped with oil-fired, aluminum melting furnaces, and in addition, crucible melting tilting furnaces are installed in each. In Fig. 5 is shown a Kroeschell-Schwartz gyrating flame, tilting furnace, installed by the Kroeschell Bros. Co., Chicago. It has a capacity of 140 pounds of aluminum per heat, which can be poured every 25 minutes. Fuel oil is used, with air at a pressure of 1½ pounds, and 1 gallon of oil will melt 100 pounds of aluminum. When using gas, 300 cubic feet are required for 100 pounds of metal. When melting aluminum, the crucibles are guaranteed for 100 heats. The metal is charged through the sliding cover in the top and the condition of the metal can always be seen by the melter by pushing aside the cover of the pouring spout. In the event of the breakage of the pot, the metal can be tapped out through an opening near the bottom of the side of the furnace, closed with a flap door. In this type of furnace, oxidation is practically eliminated, insuring a clean metal and sound castings. A Rockwell crucible tilting furnace, installed by the Rockwell Furnace Co., New York City, for melting aluminum, is shown in Fig. 7 The air is delivered to the furnaces from an overhead main from the blower plant. The other aluminum furnaces are simple in construction, being made of steel plate lined with fire brick. The cover handles are pivoted in the center, which permits the covers to be swung aside when ladling out the metal or charging. Each melting unit is provided with a metal storage locker, Fig. 6, entirely enclosed with heavy wire netting, to which the melter only has access. This arrangement permits of keeping an accurate record of the metal used in each foundry unit.

Molding machines of all types are used extensively throughout the plant,

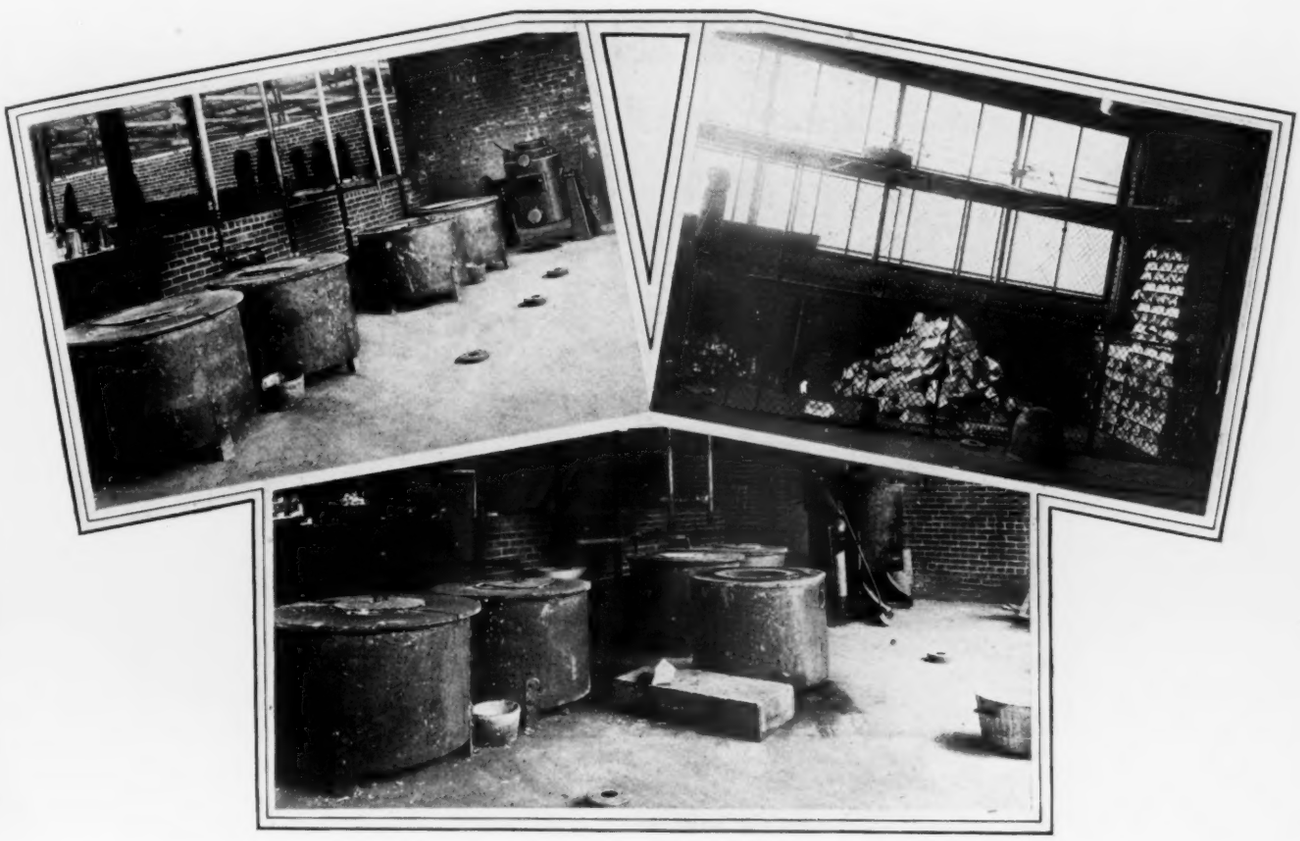


FIG. 5—MELTING DEPARTMENT OF ONE OF THE UNITS FIG. 6—ONE OF THE METAL STORAGE LOCKERS
FIG. 7—ANOTHER ALUMINUM MELTING UNIT

the work being mounted on the machine to which it is best adapted. One of the units, in which considerable machine molding is done, is illustrated in Fig. 11, and details of machine work are shown in Figs. 8, 9 and 10. A large Tabor power roll-over, on which is mounted the pattern of a four-cylinder aluminum crank case, is illustrated in Fig. 8. The flask is 25 x 39 inches, the drag being made on the roll-over machine and the cope on a Pridmore stripping plate machine. The drag is 9 inches deep. A pair of Cleveland drop plate and stripping plate molding machines is shown in Fig. 9. Drag and cope halves of a crank case mold made on these machines, are shown in the foreground. The drag is 9 inches deep. The Pridmore stripping plate machine, on which the cope halves of the four-cylinder crank case molds are made, is shown in Fig. 10. As previously stated, the drags are molded on the roll-over machine, Fig. 8. In addition to the stripping plate machine, it will be noted that Fig. 10 also shows one of the copes, as well as drag and cope sides of one of these aluminum crank cases. The drag and the large main body core are shown at the left.

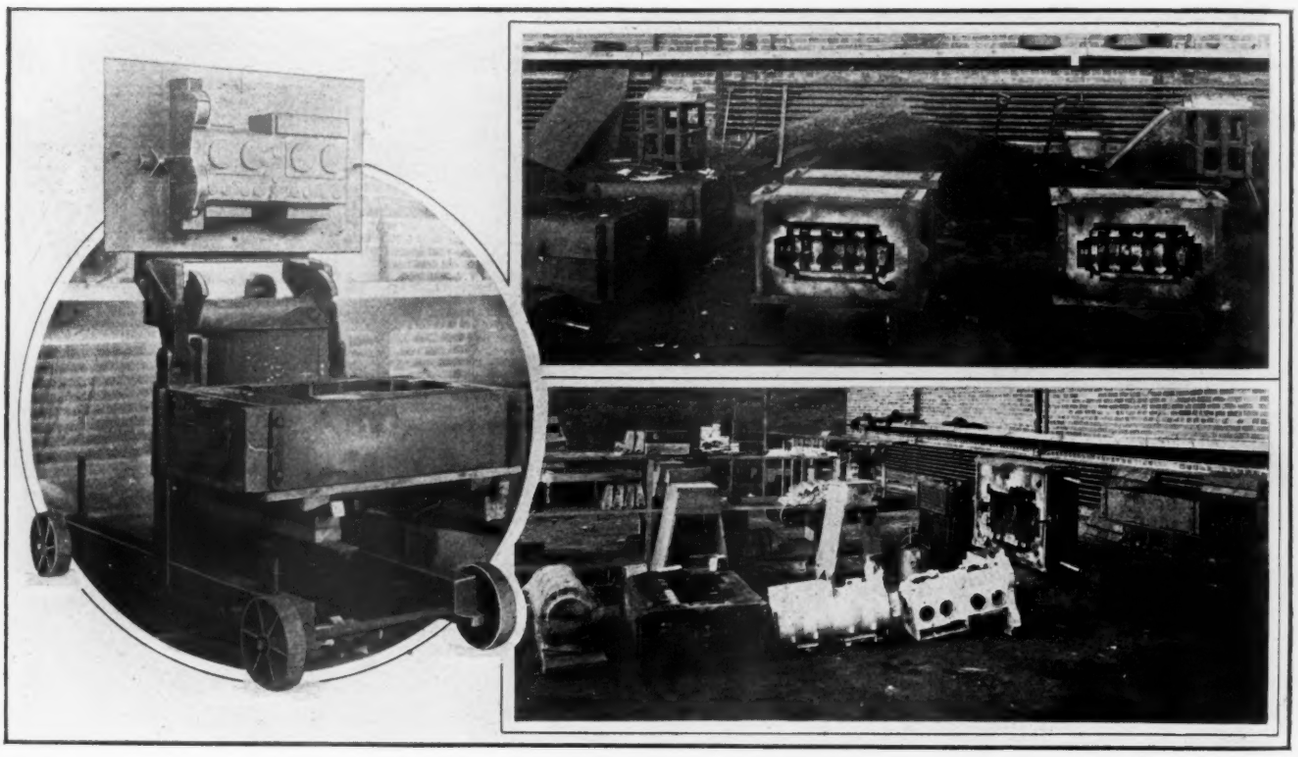


FIG. 8—LARGE ROLL-OVER MOLDING MACHINE ON WHICH THE PATTERN OF A FOUR-CYLINDER CRANK CASE IS MOUNTED

FIG. 9—A PAIR OF DROP PLATE AND STRIPPING PLATE MOLDING MACHINES, SHOWING MOLDS IN THE FOREGROUND

FIG. 10—COPE HALF OF FOUR-CYLINDER CRANK CASE MOLD AND THE STRIPPING PLATE MACHINE ON WHICH IT IS MADE, ARE SHOWN AT THE RIGHT. CRANK CASE CASTINGS, DRAG HALF OF THE MOLD, AND THE MAIN BODY CORE ARE ALSO SHOWN

Light and Ventilation.

The plant was designed with a view of obtaining an abundance of light over all the molding floors and in all departments. As shown in Figs. 12 and 14, the sides and the monitors are practically all glass, with rows of windows in the ends of each unit. The glass in the sides of the monitors is 10 feet 6 inches high and extends the length of the plant. To insure ample ventilation, the plant has been equipped with sash manufactured by David Lupton's Sons Co., Philadelphia. The sash on the sides of the monitors are in two series, and are equipped with the Pond opening device, permitting the sash to be thrown out at the bottom, which prevents the entrance of rain and snow in stormy weather, and at the same time provides ample ventilation. Over the melting floors additional ventilators are located in the roof. The roof is made of reinforced concrete tile laid on the steel frame-work.

That the welfare of the employes has been carefully considered is indicated by the excellent sanitary arrangements of the plant. Wash-rooms, as well as lunch-rooms, are located in a gallery over each core room. Each unit is provided with a toilet, those in the foundries being located at one end of the shop, on a platform about 5 feet above the ground level.

On all molds, copper pouring cups, lined with molding sand are used, and by banking sand around the cup on top of the mold, and by lifting off the cup while the metal is still molten, these cups can sometimes be used throughout the day.

MONEL METAL.

Monel metal is smelted from a nickel ore found in Canada. This ore contains nickel, copper and iron in a natural alloy, and no attempt is made to separate these metals, consequently it is to be expected the proportions will vary a little. An analysis of a number of samples made by the Oxford Copper Co. gave the following result: Nickel, 70 per cent; copper, 28.874 per cent; iron, 1.00 per cent; carbon, 0.112 per cent; sulphur, 0.014 per cent. The high percentage of nickel makes the metal difficult to melt, the temperature necessary being 2,400 degrees Fahr.

The metal is sold in the form of spatters, which are easier to melt than ingots would be, and is generally melted in clay-lined crucibles because nickel absorbs carbon from the ordinary graphite pots. These clay-lined crucibles resemble the steel melting types, as that shape is better adapted to resist the high temperature without crushing than

the regular brass shaped crucible would be.

Monel metal should be treated much like crucible steel, both in melting and molding. The ordinary brass furnace takes too long to melt the metal, as it soaks in the fire and absorbs gases, which make the casting porous. Consequently, it will pay in the end, to build a furnace especially for melting Monel metal when quantities of such castings are made. The essential features of such a furnace are good draft, and a depth sufficient to allow plenty of fuel both above and below the crucible. The latter should be placed on a base which rests upon the grate bars and is placed in position before the fire is lighted. This base should be of refractory material and as large in diameter as the bottom of the crucible, otherwise, when the heat has softened the pot, the bottom will be pushed up. The base should be at least 4 inches in height, and 6 inches, if this height can be allowed in the furnace. Before the crucible is coked, the base must be carefully cleaned off and a handful of silica sand placed thereon. This acts as a parting and prevents the crucible from sticking to the base. The pot should be charged before being placed in the furnace, a little broken glass and salt being used as a flux. A cover is then luted on. This cover is merely the bottom of an old crucible. It should be provided with a 2-inch hole in the center, so that the progress of the melt can be observed. This hole is covered with fire brick. The top of the cover should come even with the bottom of the flue. This therefore gages the depth of the furnace, which will be found to be deeper than the average brass furnace.

The pot, with its cover on, is coked up around the sides the same as for copper, the difference lies in the fact that with such refractory metals it is necessary to entirely bury the pot in fuel, heaping it above the cover on the pot but not choking the flue. The furnace can be allowed to run for at least 30 minutes and sometimes 45 minutes before receiving attention. Then, the coke around the pot has burned out and the incandescent coke on top must be pushed around the pot, taking care that the base also receives its share of fuel, otherwise the metal will be chilled in the bottom of the crucible, and the base and crucible will stick together. When this hot fuel has taken the place of that which has burned, more cold fuel is thrown on top of the pot to be heated for the next recoking. In this manner the pot is never chilled by the addition of cold fuel, the latter being heated by the waste gases, and the metal is rapidly melted.

When cold metal is to be added to the first charge in the crucible to take out a full pot, it should be done before the first charge has become liquid. When the metal sinks down in a pasty condition is the proper stage to make additions. This condition can be ascertained by probing through the hole in the cover with a thin iron rod. The cold metal should be added through a piece of 2-inch gas pipe, with a funnel on the end. This is repeated until the pot is as full as desirable, when the metal should be entirely melted down and superheated to a milk-white color. Before pouring, a small quantity of aluminum is added to impart fluidity and prevent blow-holes.

The molds should be made of refractory sand, such as silica, which is mixed with enough fire clay and molasses to give it the necessary plasticity. The molds should then be coated with silica wash and skin dried or dried in an oven, as thought best. There is little probability that Monel metal will supplant brass for ordinary castings. It is used because of its strength, color and ability to resist corrosion, and is a very valuable metal.

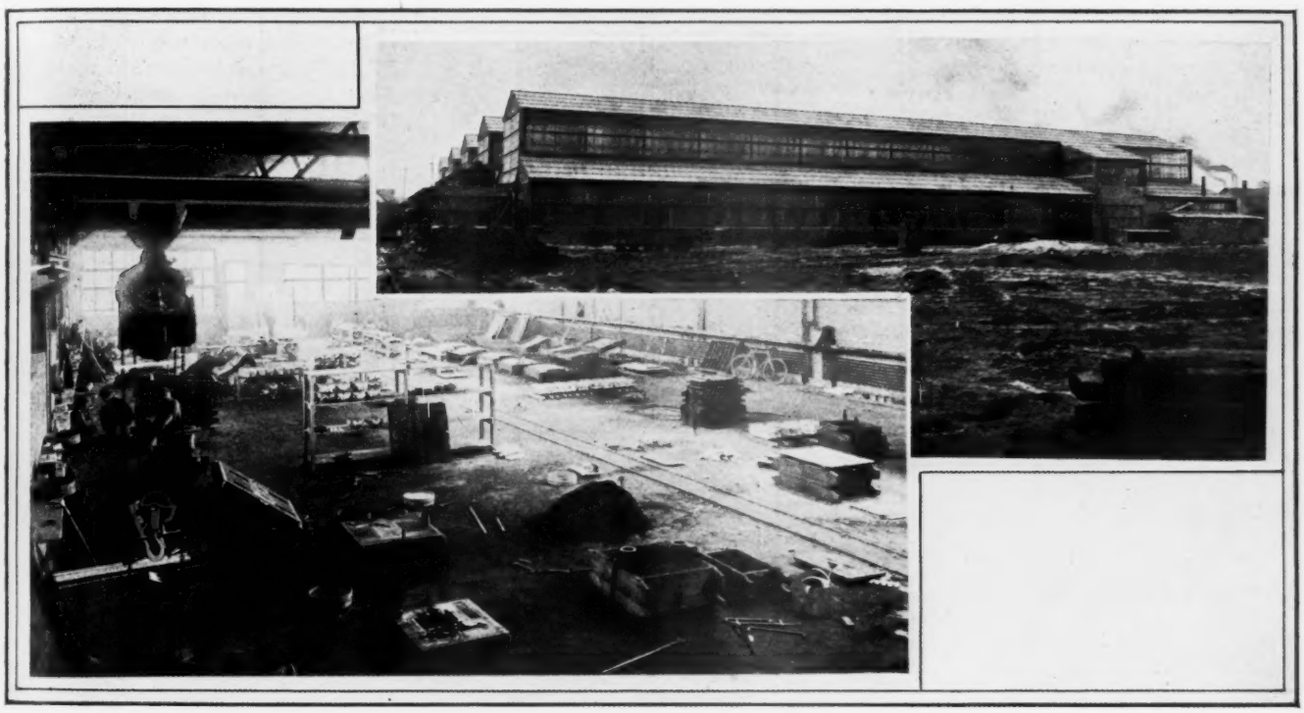


FIG. 11—INTERIOR VIEW OF ONE OF THE FOUNDRY UNITS IN WHICH LARGE FLOOR WORK IS MOLDED

FIG. 12—A VIEW OF THE FIVE COMPLETE UNITS, SHOWING THE ROWS OF WINDOWS IN THE SIDES AND THE GLASS IN THE MONITORS AND IN THE ENDS OF THE BUILDING

RUNNING COPPER CASTINGS WITH A HORN GATE.

A heavy gate is considered necessary for running copper castings, and with certain kinds of copper this is particularly true. However, there are exceptions to every

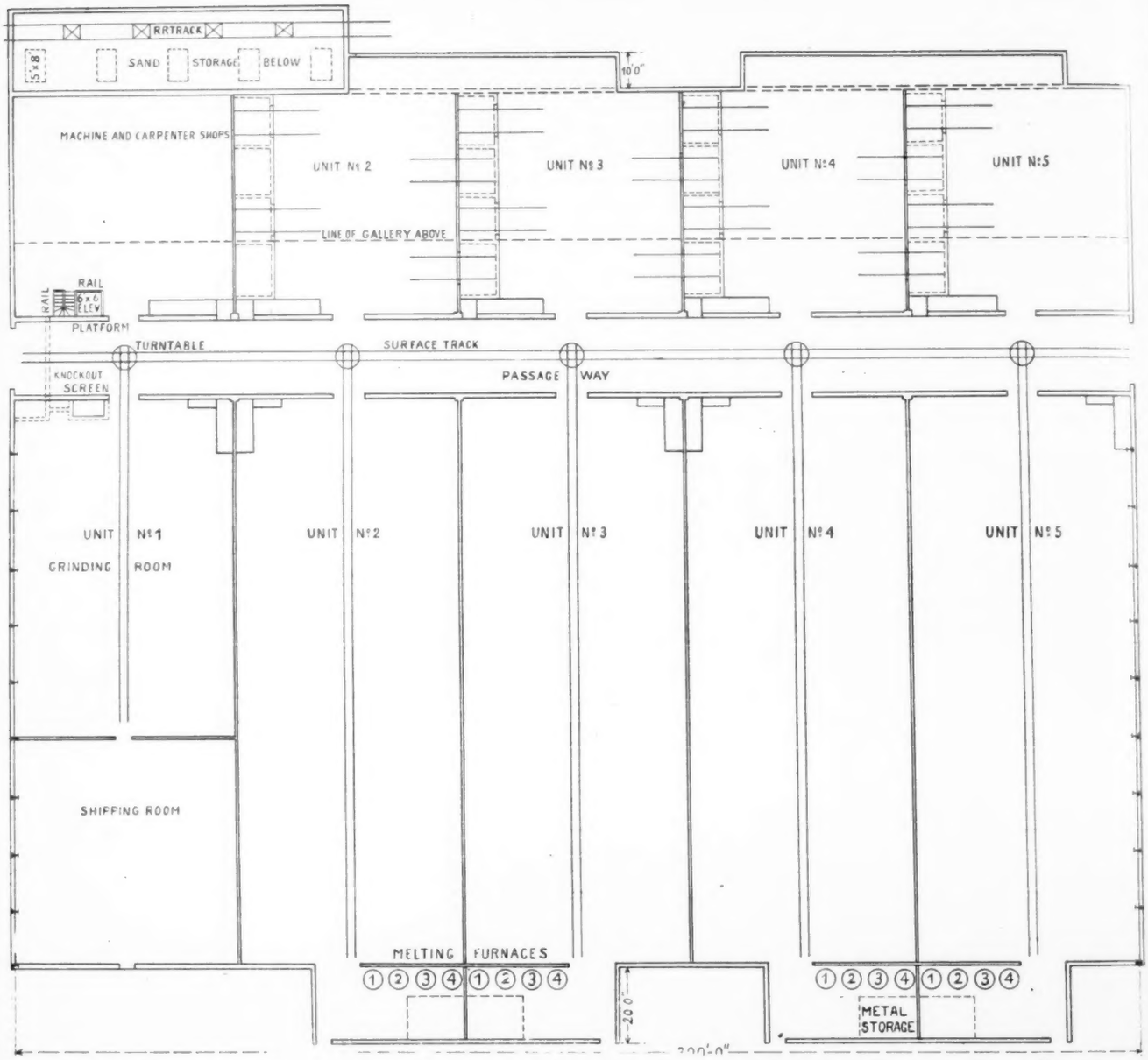


FIG. 13—PLAN VIEW OF THE FIVE COMPLETED UNITS OF THE ALUMINUM CASTINGS CO.'S DETROIT FOUNDRY. PLANS PROVIDE FOR THE IMMEDIATE ERECTION OF THE ADDITIONAL FIVE UNITS

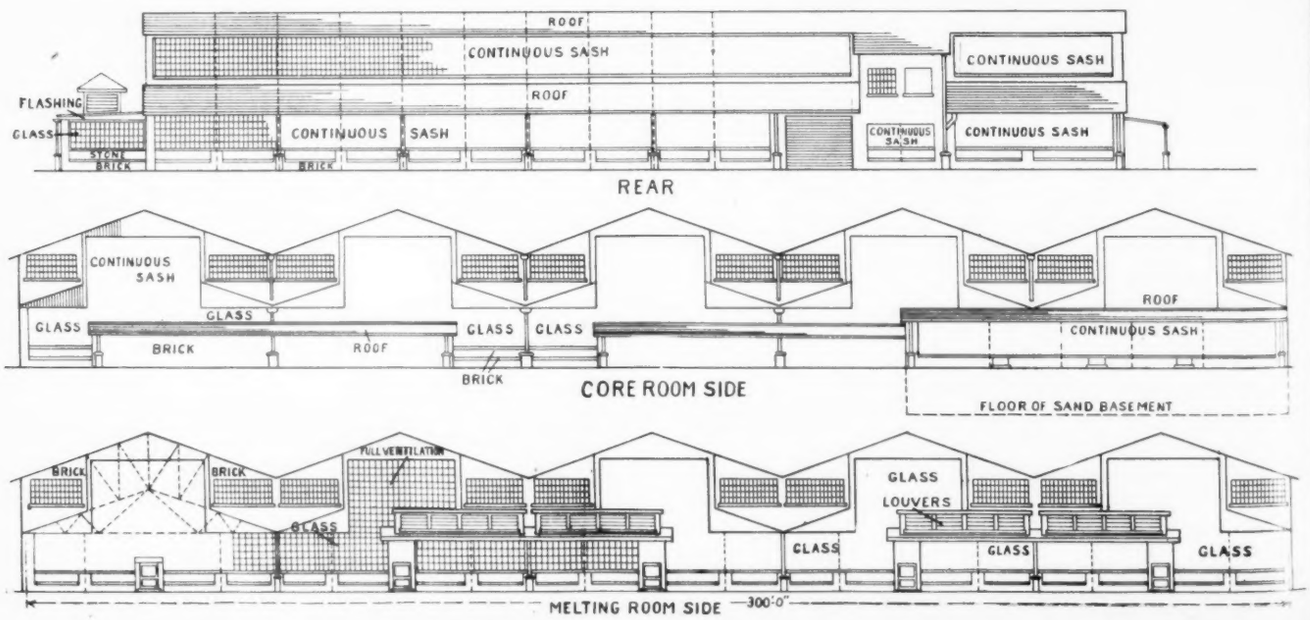


FIG. 14—REAR AND SIDE ELEVATIONS OF THE FOUNDRY

tle and one was noted during a visit to a large brass foundry some time ago. These castings were rings from 18 inches to 2 feet in diameter, of heavy section, and ordinarily would have been run with a heavy gate and several risers; but in this case only a horn gate, not much larger than a finger, was used. The castings were perfectly solid with no shrinkage, either externally or internally.

The metal used was a common casting copper containing small percentages of zinc and tin, which ran about the same as ordinary bronze, with possibly a little greater tendency to shrink. The reason why these castings were being successfully made with such a gate was because the proper pouring temperature had been accurately determined. It had been found by experiment that there was a critical point in the temperature of the metal, and if the castings were poured when this point was reached they came clean and perfectly solid, but if the metal was either hotter or cooler, the result was scrap, as the castings would shrink in a manner any foundryman would naturally expect. This pouring temperature was plainly visible to the experienced eye and could be accurately gaged by the melter, as is indicated by the fact, that in this foundry, these castings were periodically made in large numbers, being always run with a horn gate, and the percentage of loss was very small, which shows how important a factor the temperature is at which the metal is poured into the molds.

As the pyrometer was not in use in this foundry it is not possible to give in degrees the heat at which the metal was poured, and if it were so given, the information would be of little value to the trade, as pyrometers are not yet extensively used in brass foundries. Therefore there is no way to convey to the reader what this temperature was other than to use such vague terms as "medium heat", "bright red heat", "not too cool nor too hot, etc.," so that it becomes a point to be individually determined by experiment and consequently leaves a good opening for failure.

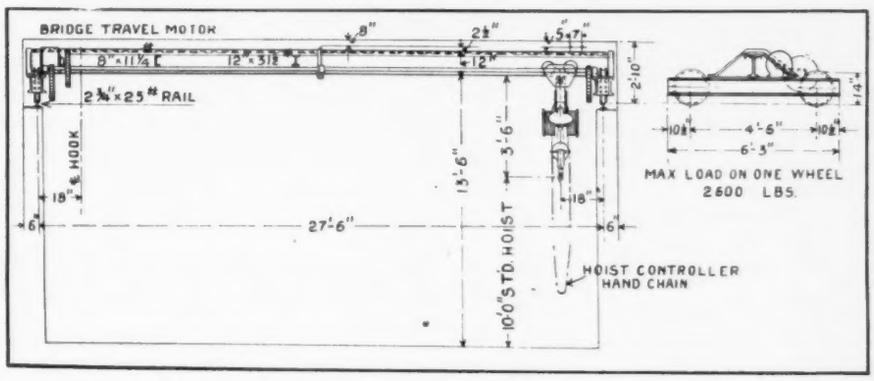


FIG. 15—ONE OF THE CRANES EQUIPPED WITH AN ELECTRIC HOIST

World's largest aluminum foundry, as it will appear when ten units are completed.

Introduction of Phosphorus into Bronze

By C. VICKERS

FROM the superintendent of a large brass foundry the following communication has been received: "In the May number of THE FOUNDRY, page 135, was published an article, describing the difficulties of introducing yellow phosphorus into molten bronze. I have used the following method with success: Yellow phosphorus must be kept under water, and in order to get it dry, so that it can be introduced into the molten metal without danger, I take the long sticks out of the original can, one at a time, and immediately plunge them into a pail of water which I have ready, and the sticks of phosphorus are broken into several pieces. These pieces are afterward placed in an earthen vessel, I use a gallon crock. This is about two-thirds full of a strong solution of sulphate of copper, with an excess of the sulphate in the bottom. The copper will form a coating over the phosphorus, and after a few hours the pieces of phosphorus may be taken out and dried in the air, without danger, as it is completely coated with copper. These pieces may then be weighed and charged into the molten metal, one piece at a time, while the metal is still in the furnace."

There is always danger in handling phosphorus, whether it is copper-coated, nickel-plated or whitewashed, and for that reason the writer has refrained, for many years, from advising this method of using this poisonous chemical. In the hands of an expert, such as this correspondent, this method may be reasonably safe, but those who ask advice are not all experts on this particular point, or they would not seek information. Therefore, if they must adhere to this archaic method, it is better for them to use the uncovered article. They then know it is necessary to exercise care, and the dangers of accidents will be largely reduced. A published criticism of this article takes exception to the advice given to use phosphor-copper instead of yellow phosphorus. The author, in his superior wisdom, advises the use of this same antiquated copper-plating method, and attempts to show what a simple, childish trick it is to handle

phosphorus, and explains how easy it can be fondled with soft rags. He suggests placing it in a phosphorizer, explains how to push it into the metal, and he even takes the pains to describe a phosphorizer, so that it is very evident that this advice is intended for the inexperienced. The man who has handled phosphorus knows that there are a dozen little precautions to be observed. For instance, suppose the copper coating has peeled, in some unnoticed place, and you are through with the "soft rag" (in a brass foundry, too) and are gently inserting it in your nice, warm phosphorizer, and that uncoated spot gets busy, what then? And this peeling of the copper coating is no remote possibility, but a certainty if the deposit is too thick. The advice to use red phosphorus, too, is excellent, in view of the fact that this substance costs nearly three times as much as the yellow variety, and is procured with great difficulty. It is astonishing that such advice should be given at this day, when rich alloys of phosphorus are so easily procured, and those who give this advice, must imagine the brass founder is too dense to be alive to the convenience of having experts handle this dangerous product for him, which can be had, alloyed with copper or tin, so that the foundryman can add any desired percentage to the metal that he desires.

Brass Foundry Difficulties

SOLVED BY EXPERTS

Bronze Mixture for Pump Collars.

We wish to obtain a good bronze mixture for making sand pump collars. These pumps are used in pumping sand and phosphates out of mines, and the collars are 10 inches in diameter and ¾ inch thick, with a 4¼-inch opening in the center. They must withstand a tremendous pressure. We have been making them from common scrap brass, but desire to make them a better quality. A foundry in our vicinity makes a metal called silver bronze and charges 70 cents per pound for it. The color is a rich red, but we thought a silver bronze should be white, or nearly so. Another bronze used here is called Trojan bronze and is very yellow. Can you give us the analysis of this metal, as we have 1,000 pounds on hand and do not know how to use it to get the best results?

A good phosphor bronze will answer the requirements, and the following can be recommended: Copper, 85 pounds; tin, 10 pounds; lead, 3 pounds; and 15 per cent phosphor-copper, 2 pounds. First melt the copper, then add the phosphor-copper, next the tin, then the lead; stir vigorously.

Another mixture that can be used in case it is not possible to make a phosphor bronze, is as follows: Copper, 83 pounds; tin, 10 pounds; zinc, 5 pounds; lead, 2 pounds.

The silver bronze you mention is undoubtedly a tin bronze, similar to the formulae here given. The name "silver bronze" has been given to an alloy of a silvery color, which is made from manganese - copper, a typical alloy being, manganese-copper, 70 per cent; lead, 10 per cent; zinc, 20 per cent; aluminum 6 ounces. As this alloy is difficult to make, it would be better to use the alloy known as Monel metal, which can be purchased in ingot form.

The Trojan bronze is undoubtedly a variety of manganese bronze, and will probably contain from 35 to 40 per cent zinc, 1 per cent iron and 1 per cent aluminum, balance copper. The aluminum will make it difficult to use this bronze in ordinary red metal, and you will find it better to run it straight into a cheap grade of castings. There is a possibility that it does not contain aluminum. This is easily determined by melting, and if no aluminum is present, the metal will flare. It can then be used when making red metal, replacing the zinc in the latter.

Casting Iron on Brass.

I would like to have some information on casting iron onto brass. We are molding locomotive pedestal wedges and gibs, which are faced with brass. The iron on top of the brass is 1 inch in thickness, 6 inches wide and 24 inches long, and has a 1-inch rib on either side, giving it the shape of channel iron. The brass face is ¾ inch thick.

From the above it appears that an attempt is being made to cast the iron onto brass, which is difficult, because the melting point of iron is higher than that of brass. If the iron is poured hot, it will cut into the latter, the melted portion of which will alloy with the iron, which, we would imagine, ought to cause trouble enough to make it interesting. We suggest that the iron be poured at the lowest temperature possible at which it will run, dumping it into the mold through a large number of gates, the flanges being liberally vented on top. A better way, however, would be to cast the brass on top of the iron. The surface of the latter, where the brass runs, will in all probability have to be ground to remove the scale, then all that is necessary is to leave the molds open and when the metal is ready, heat the iron plates, set them in the molds, close, and pour before they can cool. It will be necessary to have the surface of the iron drilled with holes, or otherwise undercut, to hold the brass. In this connection, if the object of casting the iron onto the brass is to melt the two together, it will succeed better if the brass contains neither zinc nor lead. It should be an alloy of copper and tin alone, copper-tin and silicon, or copper and aluminum.

COPPER SOLDER.

We would like to have the formula of a copper solder which will very nearly have the appearance of copper, and yet which can be melted with an ordinary soldering iron.

The color of all easily fusible solders is white, as they are composed of varied proportions of tin and lead, and no process has ever been discovered of dyeing these metals and probably never will. No metal having the appearance of copper can be melted with the soldering iron, because it will be copper or very close to it, and its melting point is high.

You will have to use ordinary solder in your work and afterwards coat it with bronze paint or cover it with a deposit of copper, plated in the usual manner.

Holes in copper castings can be plugged with fine copper filings or grindings, mixed with water glass, then smoothed over.

Mixture for Brass Valves.

We would like a mixture for brass valves that will withstand a water pressure of 500 pounds without leakage.

An excellent mixture for bronze valves and one that will withstand the pressure, is as follows: Copper, 88 pounds; zinc, 2 pounds; tin, 5 pounds; magnesium zinc, 5 pounds. This makes a metal having a dense, solid fracture, light in color and perfectly free from

all discolorations. The magnesium zinc is made as follows: Melt 4 pounds of copper and when sufficiently liquid, add gradually 10 pounds of zinc, and when the zinc is melted, add 2 ounces of magnesium. Pour into ingots. Great care should be exercised when adding the zinc to the copper, so that it is put in no faster than it is dissolved. This is especially the case when the first additions are made to the copper, as there is such a small quantity of the latter that the introduction of a large piece of zinc would chill it, and the zinc would melt, but the copper would be solid in the bottom of the crucible and would not alloy. Although by superheating the zinc the copper would be ultimately dissolved, it would be at the expense of a considerable portion of the zinc, which would be volatilized.

Babbitt Metal for Small Bearings.

We would like to have a formula for a medium grade babbitt or anti-friction metal, suitable for babbitting small bearings.

A good, medium-priced babbitt is made as follows: Lead, 76 pounds; antimony, 10 pounds; tin, 14 pounds. First melt a portion of the lead, about 30 pounds, and heat it red, then add the antimony, which will be dissolved by the hot lead; next add the balance of the lead and lastly the tin. The above is a much better way than to melt the antimony first, even though it does possess the highest melting point, as the antimony will vaporize when melted alone, and a percentage is lost. The lead does not vaporize even at a red heat, and the oxidization is slight, so that it makes an excellent medium in which to dissolve the more refractory antimony. The metal runs very fluid, making a smooth, bright, slippery looking ingot, the fracture of which shows a very dense, fine grain. It is an excellent anti-friction metal.

Brass Foundry Weights.

What, in your opinion, is a handy size for brass foundry weights and about how much should they weigh?

Brass molders' weights are generally flat and rectangular in shape, the center being cut away in the form of an oblong opening which is given considerable bevel from one side. The purpose of this opening is to permit of the use of the weight on a flask where the sprue comes in the center, and for convenience in handling them, finger sockets are cast in, on two opposite sides. A good size for these weights is 13 inches wide, 15 inches long and 1¼ inches in thickness, the average weight being 60 pounds.

Easy Lessons in Chemistry

By CHARLES VICKERS

THESE articles are not intended for the chemist nor the student of chemistry, but are written solely for the benefit of the man in the shop who melts and pours the metals, and who seeks information on such subjects but finds it difficult to obtain, as text books on chemistry are not written for the foundry workers. Therefore, it is the intention to make these remarks as elementary and as easy to comprehend as possible.

In these days, when so much is written about foundry practice and the melting of metals, we read a great deal about oxygen and how carefully metals must be protected from it while melting, to prevent oxidation, thus producing spongy castings, and hosts of other troubles to worry the foundryman. Therefore, as this element seems to be such an enemy to the brass melter, we will consider it first.

Oxygen is a gas, colorless and transparent, possessing neither taste nor smell. Consequently there is no way in which the unaided sense can detect its presence, because, as it is colorless and transparent, it cannot be seen, and as it has neither taste nor odor, it cannot be detected by these senses. But it is the most widely diffused and abundant of all known substances. It constitutes one-fifth of the volume of the air we breathe, composes one-third of the solid crust of the globe, and is the chief constituent of water. The sand used in the foundry is chiefly silica, so is flint quartz and rock crystal, and about half the weight of silica is composed of oxygen. The same is true of the various kinds of marble, limestone, chalk and clay.

Oxygen is also absolutely essential to the maintenance of animal and vegetable life, as respiration depends upon the absorption of oxygen from the air, and without it, suffocation ensues. Therefore, we see how important an element oxygen is in this world and how necessary that it should exist in the atmosphere at all times, as without it there could be neither life, heat nor motion. The phenomena we call burning is nothing more nor less than the oxygen that exists in the air combining with the object that burns. This is called combustion.

Thus, life is really slow combustion. Heat is produced by combustion, therefore it follows that life, heat and motion are practically the same thing, as without the first two the latter would be impossible. Before any material will burn or combine with oxygen, it must be heated to a certain temperature. Thus, a piece of paper will not take fire of itself and fortunately there are very few substances that will. Otherwise, fire insurance would be a very hazardous risk. To burn paper we must first apply external heat in some form or other, generally by means of an inflamed match. Then, when combustion has once started, the heat generated by the burning part rapidly raises the temperature of the adjacent portions to the necessary point and the flame spreads with such increasing rapidity that it seems as if the paper burst into flame.

Whenever we light a fire, we must always proceed by easy stages. First we take some easily combustible material like paper, on this we pile something more difficult to kindle, like wood, which burns longer and gives off sufficient heat to ignite a still more difficult material to burn, such as coal or coke, but which, once started, gives out great heat and burns a long time. All of this started with the match which is applied to the paper, and the match is ignited by the heat generated by rubbing or striking it across some rough surface, in fact by friction. The match must be made of some chemical which unites with oxygen at a much lower temperature than ordinary combustible materials.

The point that it is desired to make clear is that oxygen will only combine with other substances at certain definite temperatures, when the substance is said to burn. Thus, a match is easily lighted, paper is more difficult to ignite, and wood and coal still more difficult, and it may be noted that there are few things which will not burn if their temperature is raised sufficiently high.

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Trade Outlook

Notwithstanding the approach of the summer months there has been only a slight curtailment of foundry output, and this, thus far, has only affected seasonable lines for which the demand is the heaviest in the spring and fall. Foundries producing castings for the automobile trade are not as hard pressed for deliveries as they were earlier in the year, although contracts are already being placed for the 1911 requirements of motor car builders. Malleable foundries, without exception, are operating at capacity, and the railroads are specifying heavily for steel castings. Gray iron jobbing shops report better prices and an increased volume of orders. In many shops the shortage of labor, which seems to be prevalent throughout the United States and Canada, is limiting output, and to the scarcity of skilled molders, the present rapid increase in the number of molding machine installations, is in large measure due. Common labor is commanding higher wages than at any time in the history of the foundry industry, and in Detroit, in some shops, $2.00 per day is being paid for this grade of help. The curtailment in the pig iron production, coupled with the heavy consumption, have not resulted in strengthening prices, and concessions continue to be made on desirable orders. In the south, No. 2 foundry iron is held on the basis of $12, Birmingham, although sales have been made at $11.50. It is reported, however, that the bulk of this low-priced iron has been disposed of, and the furnaces, which have been making concessions, have marked up their quotations. In other leading centers, No. 2 foundry iron is quoted as follows: Pittsburg, $16.15; Philadelphia, $16.50; Cleveland, $15.90; Chicago, $16.50; Lake Superior charcoal, Chicago, $18.50.

DEATH OF JAMES WALLACE VAN CLEAVE.

James Wallace Van Cleave, president of the Buck's Stove & Range Co., St. Louis, died at his home in that city on Sunday, May 15. Until six months ago, he was in robust health and his business associates believe that his death was due to a nervous breakdown, caused by the great demands on his strength by the litigation in which his concern was involved with organized labor.

Mr. Van Cleave was born in Marion County, Kentucky, July 15, 1849, and during the Civil War he entered the Confederate army and served under Gen. Morgan. In 1867, he engaged in the manufacture of stoves and ranges in Tennessee, and later went to St. Louis, where he formed a partnership which developed into the Buck's Stove & Range Co.

Mr. Van Cleave has been for years one of the most prominent figures in the metal-working trades and was president of the National Association of Manufacturers from 1906 to 1908, refusing re-election in 1909. On retiring from the presidency of this organization, he was given a bronze tablet with an appreciative inscription and a check for $10,000.

Previous to 1906, Mr. Van Cleave had never been involved in any serious trouble with his employes, and as a member of the National Association of Stove Manufacturers and of the Stove Founders' National Defense Association, was regularly represented in conference with the International Molders' Union. Mr. Van Cleave is survived by his wife, four sons and a daughter.

PERSONAL.

C. A. Hardy, formerly in the engineering sales department of the Whiting Foundry & Equipment Co., Harvey, Ill., has been appointed sales manager of this concern.

David Spence, superintendent of the Essex Brass Foundry, Newark, N. J., has resigned to take charge of the new foundry of the Dayton Motor Car Co., North Dayton, O.

John Hill, of the Hill & Griffith Co., Cincinnati, has been appointed vice president of the Foundry & Manufacturers' Supply Association, to succeed William Lodge, who recently resigned.

Peter J. McEntee, who has been connected with the Pennsylvania Steel Co. for over 20 years, has been appointed superintendent of the plant of the Federal Steel Foundry Co., Chester, Pa.

S. S. Knight, general manager of the Chester Steel Casting Co., Chester, Pa., has resigned to accept the position of assistant to the president of the Scullin-Gallagher Iron & Steel Co., St. Louis.

J. J. Brooks Jr., general sales manager of the Harbison-Walker Refractories Co., Pittsburg, has been elected one of the directors of this concern.

F. R. Lund has resigned as superintendent of the Lumen Bearing Co., Buffalo.

William H. Taylor has resigned his connection with the Tabor Mfg. Co., Philadelphia, to accept the position of engineer in charge of machinery advertising with the Federal Advertising Agency, 239 West Thirty-ninth street, New York City.

W. R. Dean, formerly associated with the Dean-Allen Mfg. Co., Portland, Me., has accepted the position of foreman of the foundry of the Lumen Bearing Co., Buffalo. Mr. Dean has had a

wide experience in the casting of manganese bronze and general jobbing brass foundry work.

Edwin A. Allen, who was for several years in charge of the engineering department of the Atlas Car Mfg. Co., has taken charge of the industrial department of the Chicago sales office of the Ohio Ceramic Engineering Co., Cleveland. The latter concern is engaged in making core oven, coke and pig iron cars, and also general shop cars.

R. A. Brown, associated with the Joseph Dixon Crucible Co., Jersey City, N. J., for the past 16 years, has severed his connection with that concern and is now affiliated with the Jonathan Bartley Crucible Co., Trenton, N. J. Mr. Brown is now on his way to South Africa and will make an extended trip to all of the civilized countries of the world.

J. R. McColl, affiliated with the engineering department of the American Blower Co., Detroit, has tendered his resignation, to become effective as soon as the necessary changes in the engineering force can be satisfactorily made. Mr. McColl will become a member of the firm of Ammerman, McColl & Emerson, successors to Brush, Anderson & Ammerman, consulting engineers, Penobscot building, Detroit. For about five years Mr. McColl has had charge of the engineering work of the heating and ventilating department of the American Blower Co., and since the consolidation of this concern with the Sirocco Engineering Co. he has made a specialty of mine ventilation.

IRON AND STEEL WORKS SUPPLEMENT.

A Supplement to the Directory to the Iron and Steel Works of the United States, compiled by the American Iron and Steel Association, 261 South Fourth street, Philadelphia, containing 160 pages, has recently been issued. This Supplement gives complete lists of the new plants that have been built and new companies that have been organized since the appearance of the 1908 Directory, all information being brought down to March, 1910; also the most important changes in offices and officers of firms and companies that have taken place in the same time. It likewise contains complete lists of Bessemer steel works, open-hearth steel works, steel castings works, rolling mills, etc. New features embrace a complete list of the manufacturers of billets and sheet and tin plate bars, a complete list of the manufacturers of muck and scrap bars, also of the manufacturers of iron and steel merchant bars, of rolled iron and steel concrete bars and a list of the electric steel works of the country which have been completed, under construction, or projected.

This Supplement is furnished by THE FOUNDRY, Cleveland, at a price of $6.00.

DEATH OF J. FRANK DYE.

J. Frank Dye, familiarly known by foundrymen throughout the United States and Canada through his years of connection with the molding sand business, died at his home in Avondale, near Cincinnati, on Thursday, May 19. In 1884, he organized the Newport Sand Bank Co., Newport, Ky., capitalized at $100,000, and continued as president and treasurer of this concern until his death. The sand, which was mined from the hills in the Highlands in this region, found a ready sale in all parts of the

J. FRANK DYE

world, shipments at various times having been made to China and Japan. Possessed of a genial personality and ever ready to advise with foundrymen to best meet their requirements for their line of work, Mr. Dye made lasting friendships with those in charge of casting plants in every section of the United States and Canada.

He was born at Cold Springs, Ky., May 23, 1850, and was 60 years of age at the time of his death. He received his education at the Pettit seminary at Cold Springs, where the earlier years of his life were spent. He also founded the Daylight Building & Savings Association, of which he was president. Four sons by his first wife, and one son by his present wife survive him. The children are, J. Frank Dye Jr., San Francisco; Cleveland H. Dye, Pittsfield, Mass.; Dudley A. Dye, Harrisburg, Pa.; G. Wilburn Dye, St. Louis, and Van, the youngest, who is at home. A brother, George W. Dye, will assume charge of the business.

BRITISH CONFERENCE OF FOUNDRYMEN.

At a meeting of the council of the British Foundrymen's Association, held in Birmingham, England, April 16, it was decided to hold the annual conference on Tuesday, Wednesday, and Thursday, following the August Bank Holiday. This will be the second meeting of this organization held in Birmingham since the formation of the society. There will probably be five papers. An address entitled "Swedish Malleable Iron," will be delivered by G. Blume, Veritas, Sweden.

The general arrangements for the meeting are in the hands of a local committee of which R. W. Kenyon is president, and H. Sherburne, secretary. The new classification of members, associates and honorary associates, has resulted in a greatly increased enrollment. For the first time there will also be a representation from Glasgow, where a strong branch has been formed.

THE NEWARK FOUNDRYMEN'S ASSOCIATION.

The annual meeting of the Newark (N. J.) Foundrymen's Association was held May 4, when the following officers were elected: President, Franklin Phillips, Hewes & Phillips Iron Works; vice president, James Flockhart, Mahr & Flockhart Iron Foundry; secretary, Arthur E. Barlow, Barlow Foundry Co.; treasurer, G. Hannay, Oscar Barnett Foundry Co.; executive committee: Louis Sacks, Star Heel Plate Co.; James Flockhart, S. M. Miller, Meeker Foundry Co.; John Hewitt, Thomas Hewitt Sons Co., and Thomas Malcolm, Riverside Steel Casting Co.

Preceding the election of officers, the annual dinner of the association was held. In the absence of the president, J. E. Bernhard, of the Thatcher Furnace Co., Louis Sacks presided. After the members had received the annual reports of the officers, Mr. Barlow told of the work that had been done in the foundry class, which is just completing its first year at the Newark Technical School.

The Cleveland Chaplet & Mfg. Co., Cleveland, manufacturer of wrought iron chaplets and anchors, in an 8-page circular recently issued, includes a price list of chaplets with forged heads, double head chaplet with square or round plates fitted, double head chaplets, two wing tin ferrule chaplets, saddle back chaplets, water front chaplets, pointed hook chaplets, etc.

MODERN EQUIPMENT FOR THE FOUNDRY

Automatic molding machine equipped with undercutting device --- Jar-ramming core machine --- Automatic squeezer --- Melting furnace --- Bretaud converter --- Sprue cutter --- Wall type squeezer

FOR the manufacture of undercut castings, which would necessitate the setting of cores in the mold or the use of loose pieces on the pattern, that would have to be drawn by hand, the Berkshire Mfg. Co., Cleveland, has equipped its automatic molding machine with a special device which accomplishes this undercutting automatically and obviates the necessity of resorting to cores or loose pieces on the pattern. The mold is undercut while the sand is being compressed, and the operation being automatic, does not add to the number of movements of the operator in making a mold. The line of work for which this automatic molding machine is adapted is greatly increased by the use of this device, and by the suitable arrangement of the pattern plate, plow points, bearing boxes with babbitt strips, dovetailed sections, etc., can be successfully molded.

An automatic molding machine, fitted with this device, on which is mounted a plate containing two patterns for journal bearings that are undercut on either side, is shown in Fig. 2. This machine produces the drag half of the mold, containing the undercut sections, while the cope half of the mold is made on the machine illustrated in Fig. 1, but which is not equipped for undercut work. The undercut section of these bearings is clearly shown in the cross-section, Fig. 4, as well as in the drag half of the mold, Fig. 3. The strips on the plate which form the undercut part of the pattern are withdrawn, as shown at the left, Fig. 9, until the mold is filled with sand and partially compressed, when the strips forming the undercuts in the mold are forced into the sand and remain in position until the compression is finished. They are then automatically withdrawn to permit the mold to be lifted from the pattern.

The operating mechanism, Fig. 6, consists of comparatively few parts, is well protected from the sand, and is so designed that all parts can be adjusted for wear. The amount of undercut can easily be adjusted to any desired depth. The undercutting strips on the pattern plate are actuated by two cams on the main shaft which throw a lever fastened to the bed plate, to which are attached two slides. At one end of a sliding rod are two fulcrums which actuate the undercutting strips in the pattern and at the other end of this rod are two rollers which move the fulcrum up and down, thus actuating the undercutting strips in

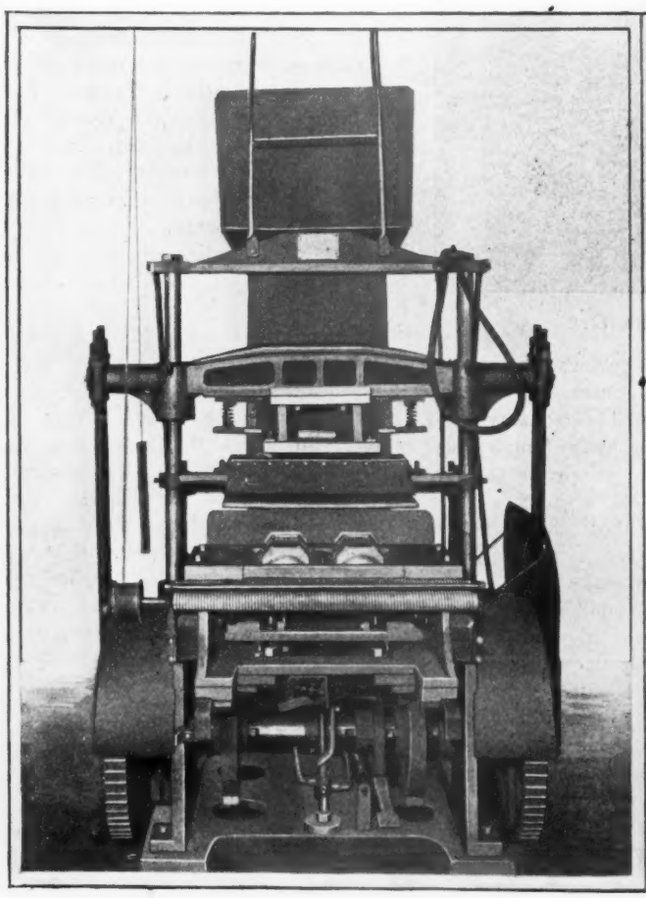


FIG. 1—BERKSHIRE AUTOMATIC MOLDING MACHINE ON WHICH THE COPE HALVES OF THE JOURNAL BEARING MOLDS ARE MADE

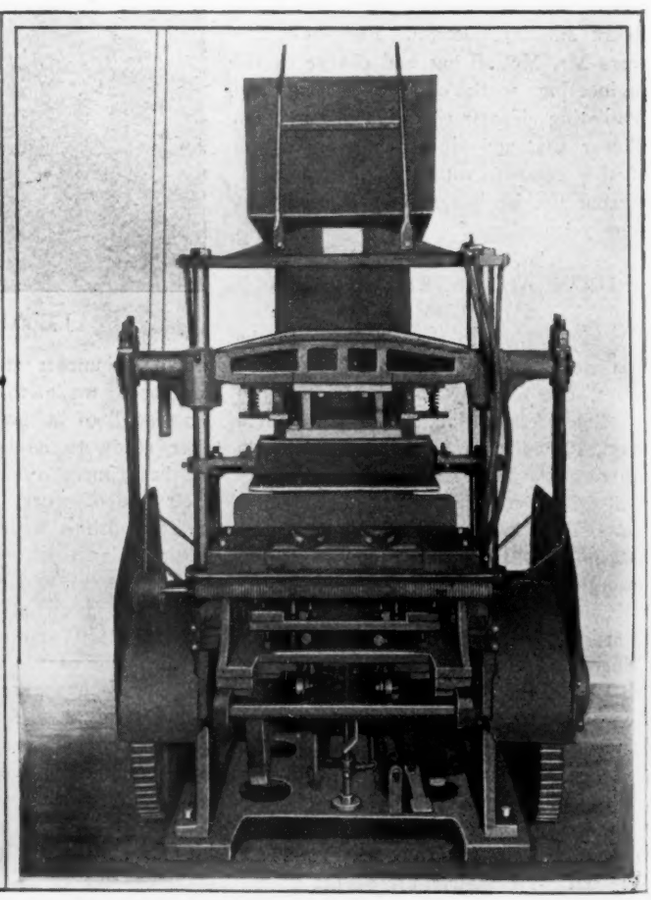


FIG. 2—BERKSHIRE AUTOMATIC MOLDING MACHINE ON WHICH THE DRAG HALVES OF THE JOURNAL BEARING MOLDS ARE MADE; MACHINE IS EQUIPPED WITH UNDERCUTTING DEVICE

the pattern. In operation, the cams move the upright levers, thus forcing the slides underneath the rollers, thereby moving the strips in position. After the undercutting strips have reached their highest point in the mold, the slides are drawn back to their normal position by two springs, withdrawing the undercutting strips from the mold. The adjustment for depth of undercut can readily be made by two adjusting nuts.

The reverse side of one of these pattern plates, showing the mechanism controlling the undercutting strips, is illustrated in Fig. 5. The strips, and the sleeves which operate in a shaft, are cast integral, and the openings for the posts, which are held with set screws, are shown. At the left, this mechanism is shown in the position which it assumes when the strips are in the sand, and at the right the strips have been withdrawn. The face side of the drag pattern plate is shown in Fig. 9. At the left, the undercutting strips have been withdrawn and at the right, these strips are in position for undercutting the sand in the mold. The cope plate is illustrated in Fig. 10, and is shown mounted on an automatic machine in Fig. 1. Drag and cope halves of the mold are shown respectively in Figs. 7 and 8. Inside and outside views of two

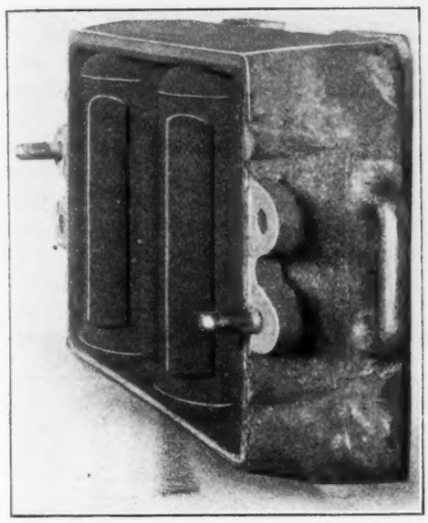


FIG. 3—DRAG HALF OF JOURNAL BEARING MOLD, SHOWING UNDERCUT SECTIONS

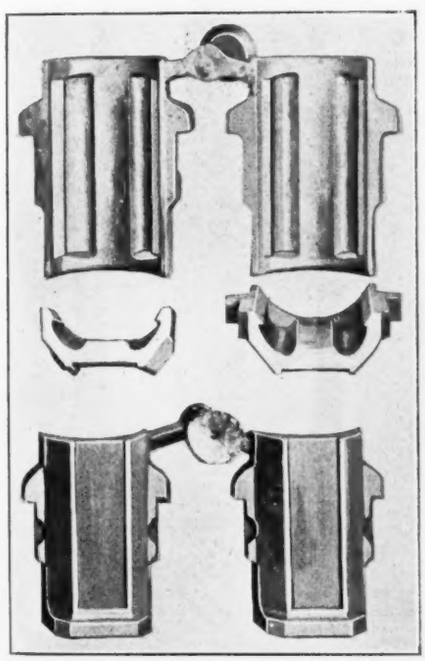


FIG. 4—INSIDE, SECTIONAL AND OUTSIDE VIEWS OF JOURNAL BEARING

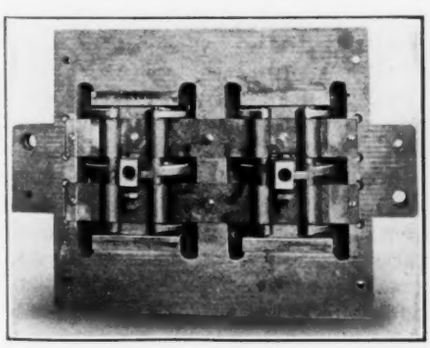


FIG. 5—BACK VIEW OF PATTERN PLATE, SHOWING MECHANISM FOR OPERATING UNDERCUTTING STRIPS

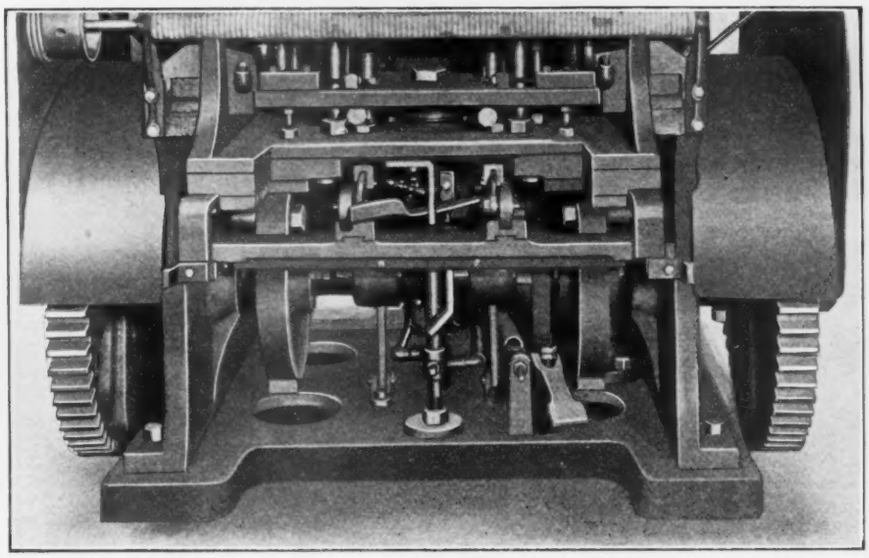


FIG. 6—AUTOMATIC MOLDING MACHINE, SHOWING MECHANISM FOR OPERATING UNDERCUTTING STRIPS

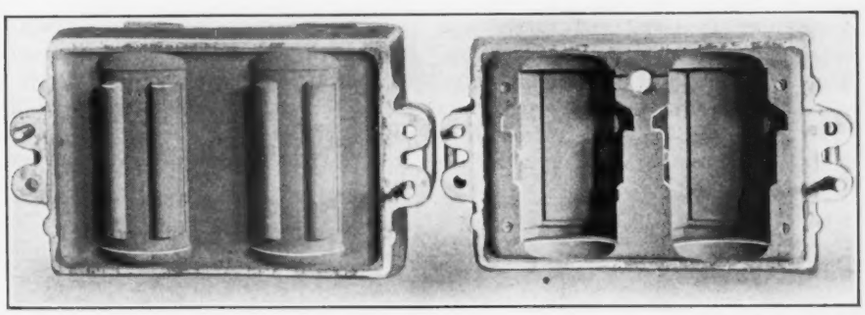


FIG. 7—DRAG HALF OF JOURNAL BEARING MOLD

FIG. 8—COPE HALF OF MOLD

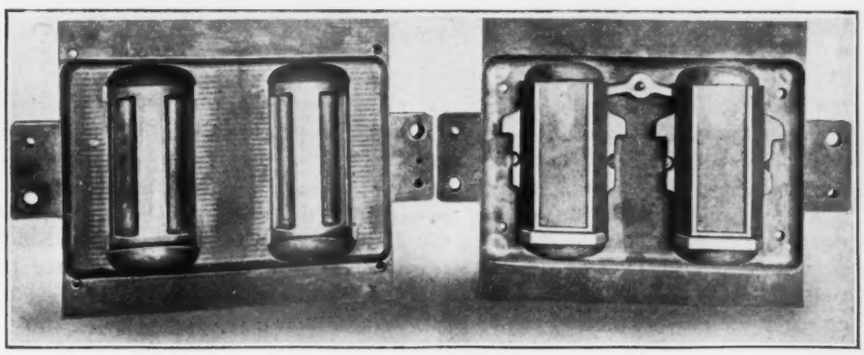


FIG. 9—DRAG PATTERN PLATE

FIG. 10—COPE PATTERN PLATE

journal bearing castings on a gate are shown in Fig. 4, and the sectional view clearly illustrates the undercut sections of the castings.

THE WADSWORTH JAR-RAMMING CORE MACHINE.

Another core machine has been added to the extensive line of core room equipment, manufactured by the Falls Rivet & Machine Co., Cuyahoga Falls, O. It is the invention of George H. Wadsworth, superintendent of this plant, and employs the jar-ramming principle for compressing the sand and is styled a vertical, jar-ramming, core-forming machine. It is adapted for making cores, ⅜ to 3 inches in diameter, and from 1 to 12 inches long, either straight or with tapered ends to conform to the prints, tapered on one end or chambered.

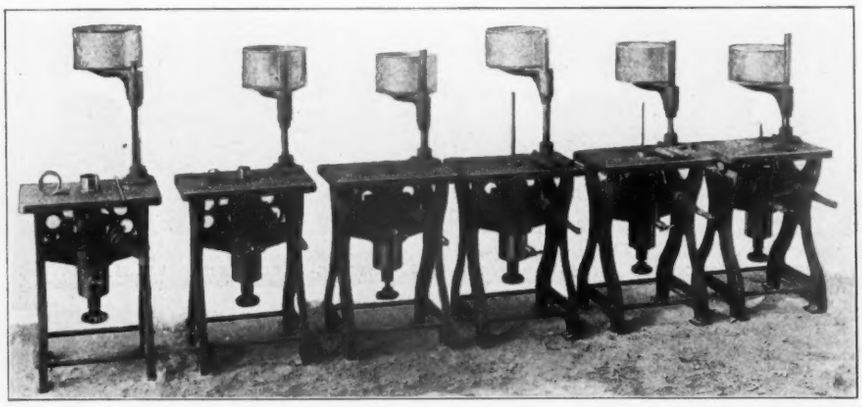


FIG. 1—BATTERY OF SIX WADSWORTH VERTICAL JAR-RAMMING, CORE-FORMING MACHINES. THE DIES HAVE BEEN LOWERED THROUGH THE TABLE

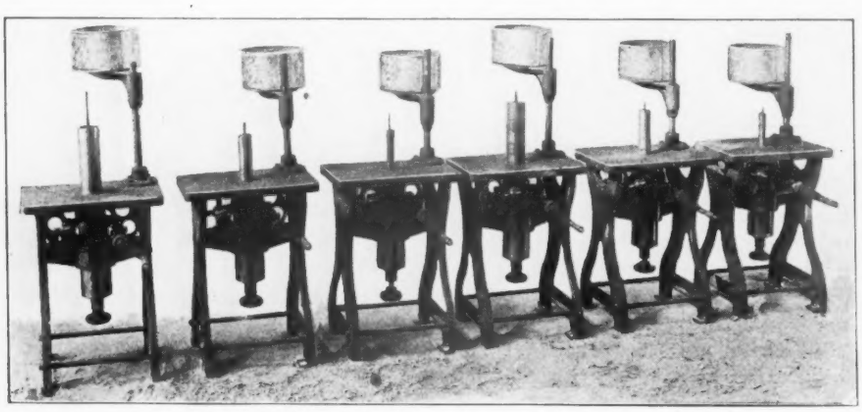


FIG. 2—THE DIES ARE IN POSITION TO FILL WITH SAND, THE VENT RODS PROJECTING ABOVE THE DIES

The machine, shown in Fig. 3, consists of a table on cast iron supports between which the operating mechanism is located. The sand is rammed by the rise and fall of a cross-head controlled by two 6-tooth cams, bevel on one side and straight on the other, coupled together with gears to operate in unison. Attached to one shaft is a crank which the operator turns with his right hand while ramming a core, at the same time feeding sand into the tube with his left hand through the opening in the bottom of the hopper supported on a post above the table. The drop can be adjusted from ⅛ to ⅜ inch by a set screw, but as yet it has not been found necessary to change the height of the drop. The blow is taken between the point of the set screw and a copper plate located in a pocket, and is not received on the table. The dies, one of which is shown in position on the machine, Fig. 3, are made of seamless steel tubing of standard sizes.

When operating the machine, the die, which operates in a sleeve, is raised as shown, and the vent wire or rod is set in the opening in the center of the stool, supported on the bottom of the cross-head. The die can be adjusted to any length within the capacity of the machine by unscrewing the wing nut on the end of the handle and raising or lowering the tube in the clamp which controls the raising or lowering of the die. The die is raised by the handle which is held by the pocket in the top of the cross-head while the core is being rammed. After the core is made, the vent rod is withdrawn and the handle is lowered in line with the slot in the cross-head, shown in Fig. 4, which permits the die to strip away from the core, leaving the core on the stool.

When making straight cores, the sand is rammed in the die, but for irregular cores special core boxes are placed inside of the tube. One of these dies for making a chambered core is shown on the stool in Fig. 4 after the tube has been lowered through the table of the machine. The lower end of these metal core boxes is tapered so that when the tube has been lowered, the two halves of the core box fall away from the core, which is left standing upon the stool. One-half of the former or core box, in which chambered cores are made, is used as a drier for baking the core.

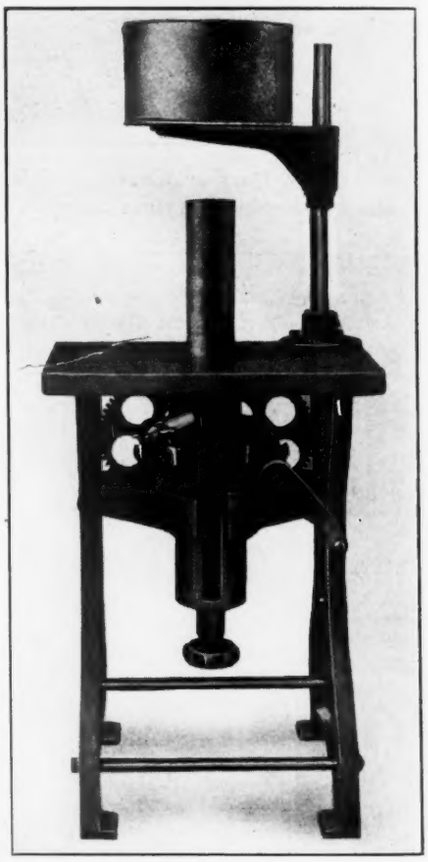


FIG. 3—WADSWORTH CORE MACHINE, SHOWING DIE IN POSITION FOR MAKING A CHAMBERED CORE

A battery of six machines is illustrated in Fig. 1, with the dies lowered, the vent rods being in the stools in the three machines at the right, while they have been withdrawn from those shown at the left. The bushing placed in the top of the die to form the upper tapered print is shown on the tables of the three machines at the left. In Fig. 5 the cores are shown on the stools after they have been rammed. The cores on the two machines at the left have tapered prints top and bottom, the bushings forming the top taper standing on the

table at the sides of the cores. The cores are held in the bushings forming the bottom print, and when they have been turned over onto driers, which are placed against the cores while in a vertical position, these bushings are removed. On the three machines at the right, chambered cores are illustrated, while a straight core is shown on the third machine from the left. On the machine with the chambered cores, the split core boxes are at one side of the table. Cores with tapered prints can be dried upright, standing in the bushing which forms the lower taper. Another view of these machines, with

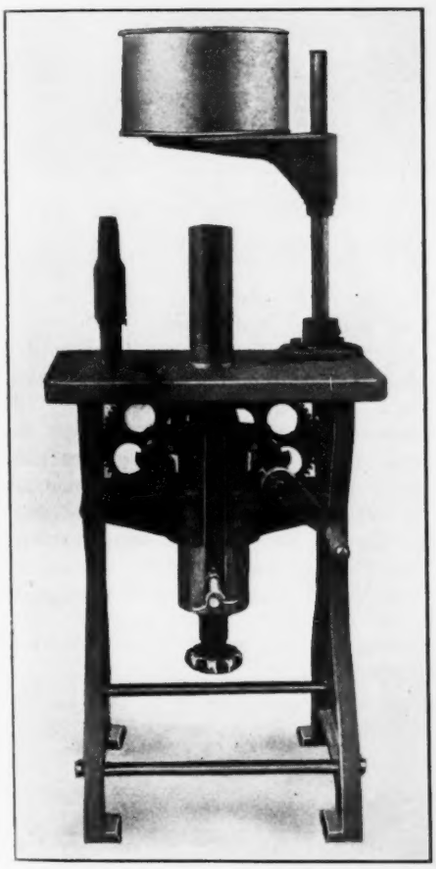


FIG. 4—CHAMBERED CORE MADE, DIE LOWERED THROUGH THE TABLE AND THE FORMER IS SHOWN ON THE STOOL

the dies in position for ramming the cores, is shown in Fig. 2. The varied line of cores that can be made on this core machine is shown in Fig. 6. They are of various sizes from 1 to 3 inches in diameter, including straight, tapered and chambered cores. It has been found that straight cores can be made of any mixture of sand on this machine, but for chambered cores a sharp sand is recommended, using flour and oil as a binder.

GIROD ELECTRIC FURNACE INSTALLATION.

A Girod electric furnace is being installed by the Simonds Mfg. Co., in the crucible steel department of its Chicago plant. This is probably the first furnace of this type to be built in this country, although many of them are being successfully operated abroad. The

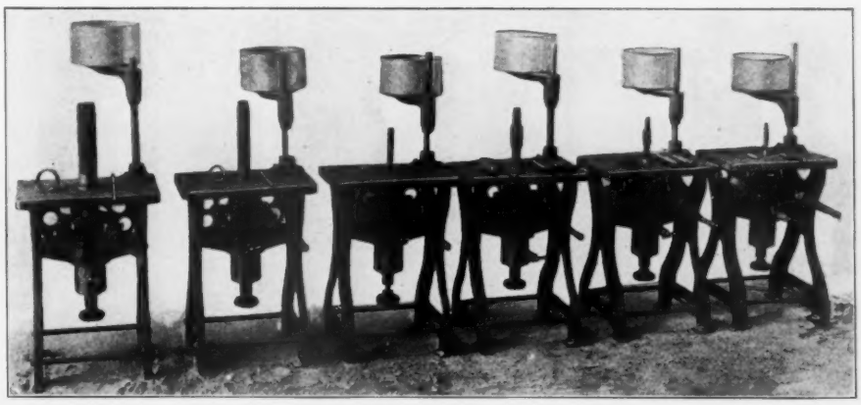


FIG. 5—BATTERY OF CORE MACHINES, SHOWING DIES WITHDRAWN AND CORES ON STOOLS ON TOP OF THE MACHINES

installation of this furnace is in the nature of an experiment by this concern and is of special interest, as a tract of 60 acres has just been acquired at Lockport, N. Y., and provision will be made to install electric furnaces in this plant, should this one come up to expectations.

These furnaces range in size from 2 to 12½ tons capacity, and when used in large steel works producing Bessemer or open-hearth steel, supply the means of refining the ordinary or partially refined product of these furnaces to a higher quality of steel than can possibly be obtained direct, at but a small advance in cost.

The Girod furnace and process also appeals to those having use for small quantities of superior quality steel for castings, or of fine steel of any description, as it enables a crucible quality of steel to be produced in quantities of tons at a melt, at a considerable saving over the crucible method.

This furnace is now in operation in ten steel plants abroad. C. W. Leavitt & Co., 32 Church street, New York City, are the American agents for the Girod furnace and are also exclusive agents for the Girod brand of alloys, such as ferro-chrome, ferro-molybdenum, ferro-titanium, ferro-tungsten, ferro-vanadium, and all special alloys such as silicon-calcium-aluminum, silicon-chromium, etc., etc.

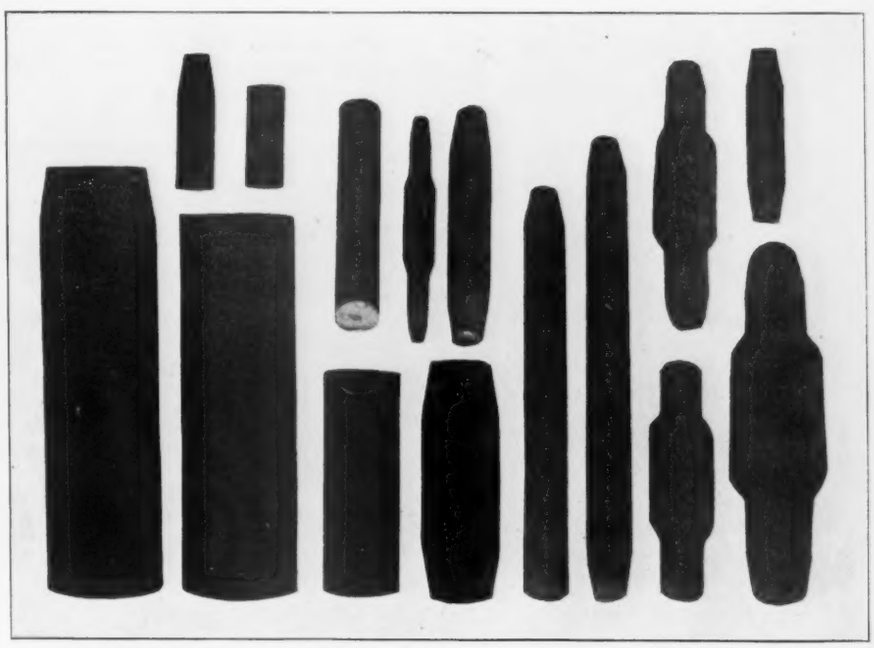


FIG. 6—ASSORTMENT OF CORES MADE ON THE WADSWORTH VERTICAL JAR-RAMMING, CORE-FORMING MACHINE

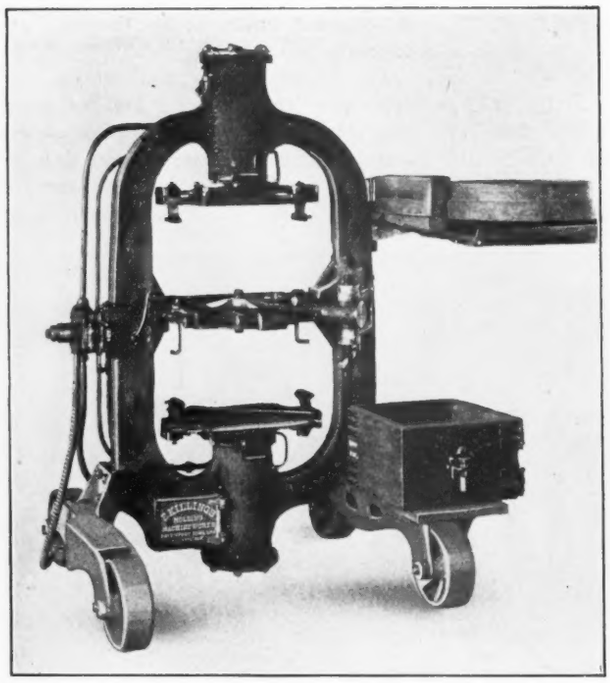


FIG. 1—THE KILLING AUTOMATIC SQUEEZER, SHOWING PATTERN PLATE INSIDE OF THE MACHINE FRAME

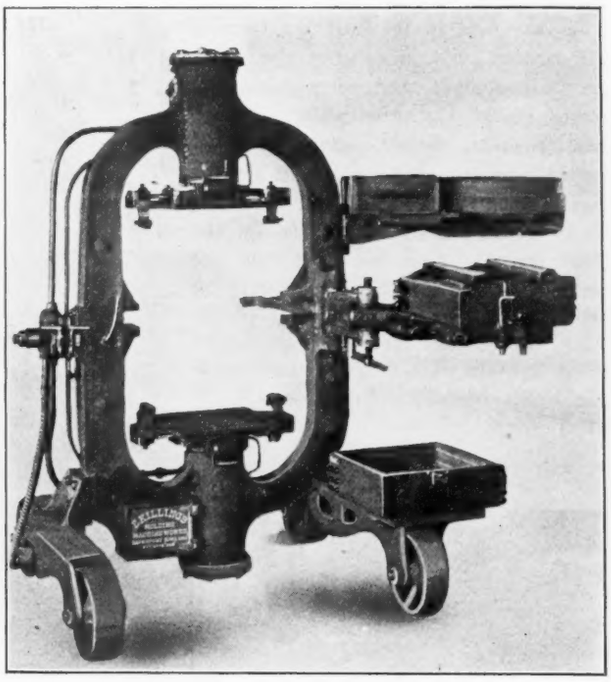


FIG. 2—PATTERN PLATE SWUNG OUT, SHOWING THE COPE FLASK FILLED WITH SAND

THE KILLING AUTOMATIC SQUEEZER.

An automatic squeezer of the duplex type, built by the E. Killing's Molding Machine Works, Davenport, Ia., which rams both cope and drag, is shown in the accompanying illustrations. Nearly all of the molding operations are accomplished by the machine, so that the operator is only required to shovel the sand and to carry off the completed molds. The sand is riddled onto the pattern by a pneumatic sand sifter, and cope and drag are squeezed in one operation. The vibration of the pattern is automatically controlled, as well as the closing of the mold.

In Fig. 1, the pattern plate is shown inside of the machine frame, and when making a mold, this plate is swung outwardly, as illustrated in Fig. 2. Sand is then shoveled into the riddle by the operator and when the riddle bracket is moved over the flask, the riddle is automatically placed in operation and the sand is sifted onto the pattern. When sufficient sand has been riddled onto the pattern, the bracket is swung back, shutting off the riddle. The squeezer board is then placed on the drag and is clamped to the pattern plate by a spring clamp, which is automatically released when the squeezing operation is begun. The drag is then revolved, which is accomplished by releasing the lever that holds the pattern plate in

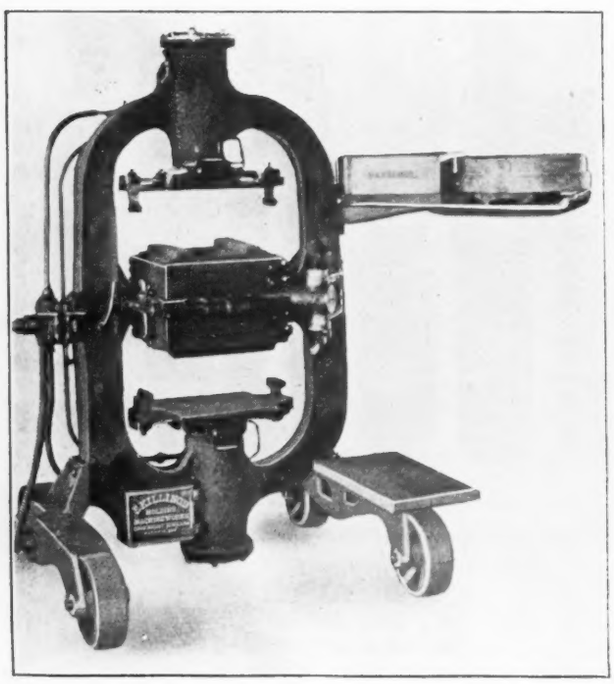


FIG. 3—COPE AND DRAG MOLDS ATTACHED TO THE PATTERN PLATE BEFORE SQUEEZING

FIG. 4—MOLD RAMMED, COPE RAISED, DRAG LOWERED AND THE PATTERN PLATE SWUNG OUT

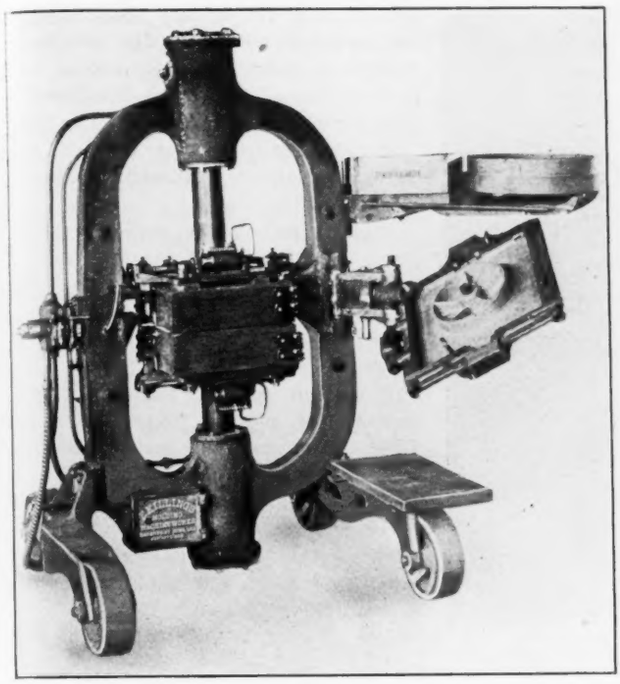


FIG. 5—CLOSING THE MOLD

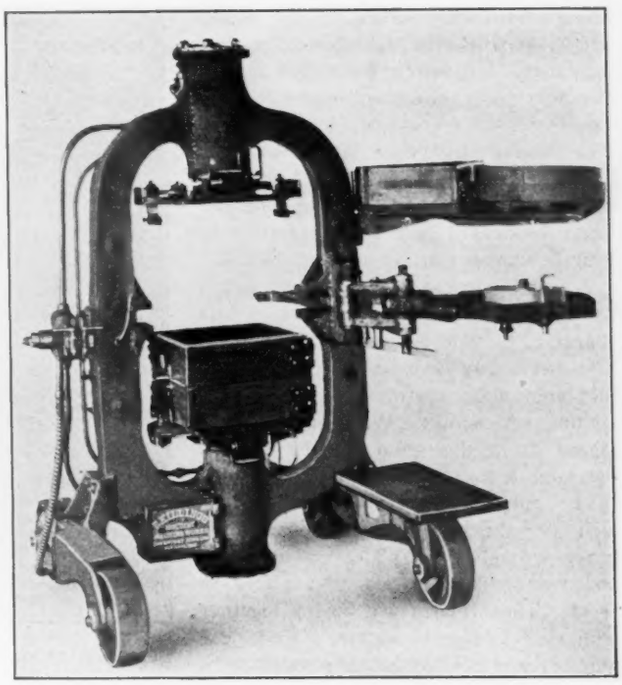


FIG. 6—MOLD CLOSED

either position for making the cope or drag. The cope side of the pattern is then turned upward, the flask adjusted, the sand is riddled onto the pattern and the same operations are performed as when making the drag half of the mold.

The pattern plate, with cope and drag flasks attached, as shown in Fig. 3, is swung inside of the machine frame. Air is then admitted to the upper and lower cylinders and both cope and drag are squeezed in one operation. In this illustration will also be seen the clamps on the pressing plates which grip the flasks firmly, these clamps being actuated by air cylinders on either plate. After cope and drag have been pressed, air is admitted to the cylinders controlling the clamps, and the flasks are firmly held while the pattern plate is vibrated. By reversing the air in the main pressing cylinders, the cope is lifted and the drag is lowered away from the pattern plate, as shown in Fig. 4. The pattern is then swung outwardly to permit of closing the mold. This is accomplished by admitting air to the main cylinders, as illustrated in Fig. 5, the drag being raised and the cope being lowered. The clamps on the pressing plate of the upper cylinder are then released and by again reversing the air in the cylinder, the entire mold is lowered by the bottom cylinder and is ready to be carried away by the operator, as shown in Fig. 6.

The machine is built in two sizes, for snap flasks up to 14 inches square, or iron flasks ranging in sizes to 16 inches square. A larger machine will accommodate snap flasks up to 20 inches square. The machine is mounted on four roller bearing wheels, 10 inches in diameter, with a 4-inch face, and the machine, being portable, can be moved along the foundry floor as the day's work progresses. This duplex automatic squeezer is the invention of Ewald Killing, patent for which has been applied.

REVERBERATORY MELTING AND REFINING FURNACE.

The reverberatory melting and refining furnace, shown in the accompanying illustration, built by the W. S. Rockwell Co., 50 Church street, New York City, is designed principally to melt with liquid or gaseous fuel, but the construction can be altered so that either coal or coke can be used. When operating with oil or gas, no stack is required, as a hood placed over the furnace is sufficient to carry off the gases and metal fumes, but if coal is used, a flue must be constructed leading from the top of the furnace to a stack.

This type of furnace has been used successfully and economically in reducing borings, turnings and miscellaneous scrap to ingots, also for melting and

A REVERBERATORY MELTING AND REFINING FURNACE

refining drosses, running down copper and brass wire into ingots, and for making metal for heavy brass and bronze castings. The charging opening is of ample size to accommodate large scrap, thus saving the time and fuel that would be required to heat and break into small pieces suitable for the crucible. Large masses of light scrap can also be melted without cutting up and baling.

When the furnace is started, it should be run for an hour or more before charging, to thoroughly heat the bottom. The metal may then be charged through the large door in front as fast as the melting will permit. When melted, it is tapped from the spout on the side in the same manner as a cupola.

The furnaces are constructed of 9-inch fire brick and are protected by heavy wrought iron plates on the sides and rear and with cast iron plates in front. These plates are bound together with steel I-beam buckstays, placed close together and held by heavy wrought iron tie rods, the front plates being protected around the opening by fire brick, and are made in sections to avoid cracking. In large furnaces, a small opening is provided on the side for stirring, skimming or observing the condition of the metal, and it is protected by a brick-lined door. The furnaces are built in sizes with capacities ranging from 1,000

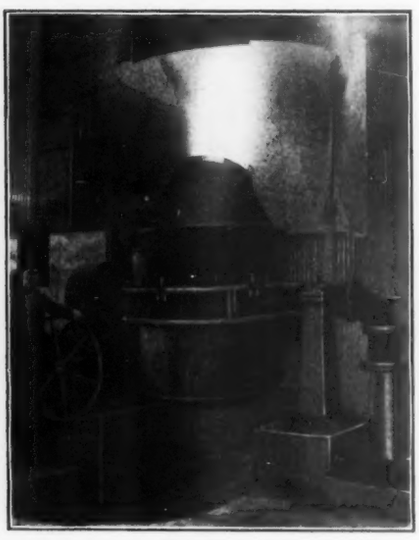


FIG. 1—THE BRETAUD CONVERTER IN OPERATION

pounds to 30,000 pounds, requiring from 300 to 1,600 cubic feet of air per minute.

THE BRETAUD CONVERTER.

A converter for the production of steel castings, which embodies many novel and practical features, has recently been developed by J. V. Bretaud, mechanical and metallurgical engineer, 488 Cass avenue, Detroit. An important item in the cost of making steel by the converter process is the wear of the

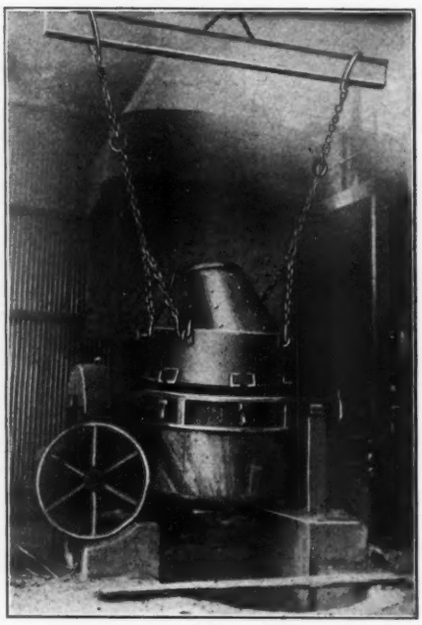


FIG. 2—LIFTING THE TOP OFF THE CONVERTER AFTER THE LAST BLOW

converter lining and the expense entailed in making repairs. As soon as the lining is out of shape, the converter must be stopped and allowed to cool off until a man can comfortably stand inside to make the necessary repairs, which generally takes from 12 to 18 hours. Furthermore, in small converters, a man has barely the space to move and his work is necessarily slow and tedious. During this time the converter is out of use, and the product of the foundry is proportionately reduced. In practice, in order to produce steel every day, it has been found necessary to have two converters, which are operated alternately. The Bretaud converter was designed to reduce this period of inactivity to a minimum and to render the operation practically continuous, thus cutting down the expense of repairs and doubling the capacity of the plant.

The converter is divided into two parts, the dividing line being the upper surface of the heavy cast iron ring, shown in Fig. 1. This ring carries the trunnions and is firmly bolted to the lower half of the converter, to which are attached the wind box and tuyeres. The top part carries two small trunnions and four eye brackets equally spaced around it, the two parts being securely fastened together by six key bolts which swing from the trunnion ring.

Each day, after the last blow, and after the slag has been cleaned off, the keys holding the top are loosened, the top is lifted off the converter by a crane, shown in Fig. 2, and placed on a pair of heavy wooden horses, the two small trunnions engaging two half boxes being bolted to the top of the trestles. This permits the upper part of the converter to be rolled over easily, bringing the mouth downwards. The two halves of the converter are then left to cool and in about four hours the lining is sufficiently cool to be patched. The lining material used is ganister, and a very refractory fire clay, ground together in a mill.

While repairing the converter top, a heavy board, cut out in the center to suit the shape of the lining, is bolted to the shell with four bolts, and ganister is rammed inside flush with the opening in the board, as shown in Fig. 3. One side is built up first, then the shell is swung over and the other side is finished. One man can perform this job with ease in about two hours, as he can use both hands and can reach the inside of the converter from both ends of the shell. When the board is removed the lining will be found to be in perfect shape.

For repairing the bottom of the converter, a wooden collapsible mold, provided with hinges and pins, is placed inside the converter, and the lining material is rammed up in the space between the mold and the lining. When this is accomplished, the mold is removed, leaving the inside hard and smooth.

A noteworthy feature is the device used for patching the tuyeres. It consists of a cast iron plate carrying six tubes, 6 inches long and machined inside.

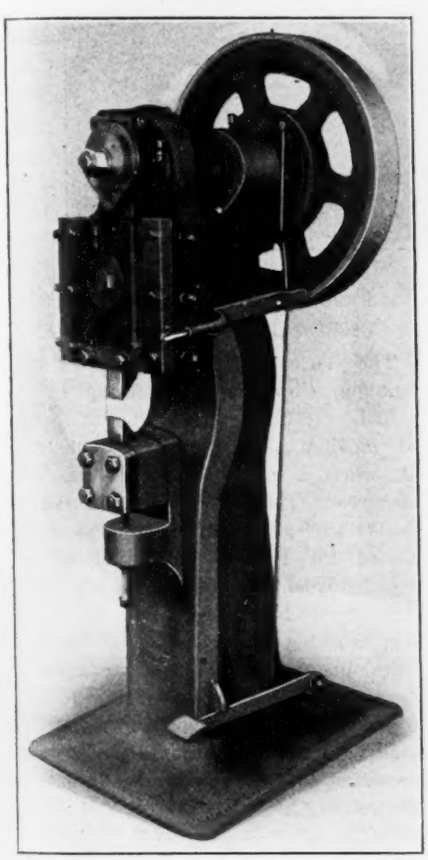
FIG. 3—PATCHING THE TOP HALF OF THE CONVERTER

This is bolted in the wind box, the tubes projecting inside the lining. When patching the tuyeres, a corresponding number of bars, machined to the bore of the tube, is inserted in the pipes and the ganister is rammed around them, leaving, upon withdrawing the bars, all the holes in the same plane, which is very important for successful blowing. When the bottom half of the converter is patched, a joint of molding sand is laid on the top of the lining and the top half of the converter is closed down.

the bolts being swung over and the keys slipped in and tightened to hold the two parts together. The converter is then ready for drying.

One advantage of this type of converter is that the lining does not have to be entirely cool before it can be patched. The converter is never cooled sufficiently to permit the hand to be placed on the shell, yet notwithstanding this, repairs can be conveniently made. If the time for making repairs is to be further reduced, a spare top can be kept lined up, ready to replace the one to be repaired.

The first Bretaud converter was in-



A NEW POWER SPRUE CUTTER

stalled in a Detroit steel foundry three months ago and another steel casting plant has placed an order for its entire melting equipment, consisting of converters of the Bretaud type. The Bretaud converter is built in three sizes, one, two and three tons each, and is furnished with all the auxiliary equipment for making steel. The one-ton converter can be lined down to one-half ton if desired.

A NEW POWER SPRUE CUTTER.

A power sprue cutter designed to meet the requirements of brass founders and other manufacturers of soft metal castings, built by the Standard Machinery Co., Providence, R. I., is shown in the accompanying illustration. This machine is furnished with both treadle and hand lever. It is so designed that the operator always has both hands free to hold and guide the work, the cutters starting automatically at the highest point of the stroke.

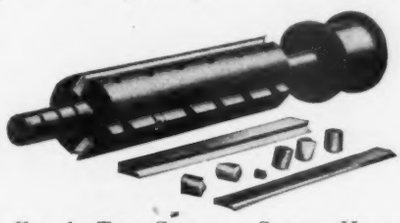


FIG. 1—THE CRESCENT SAFETY HEAD FOR JOINTERS

The overhung construction of the frame permits large, irregular castings to be operated upon.

The cutters are made of open-hearth tool steel, 2 inches square section, thus obviating the necessity of machine work in fitting, and they can be set at right angle to the front of the press if found more convenient. The adjustment of the cutters permits their use up to the last inch of their length, and they may be accurately set to just cut off the gates without touching each other, thereby preserving the cutting edges.

The frame is rigidly constructed and is designed to give large working space and to permit the operator to conveniently handle all kinds of work. The sprue cutter is fitted with a clutch, permitting it to be operated continuously, or stopped at each stroke. The clutch is so designed that there is less than 1/32 inch travel on the periphery of the fly wheel after it engages or disengages, thereby effecting a saving in power and eliminating loss in friction.

The general dimensions of the machine are as follows: Over-all height, 6 feet; stroke, 1¼ inches; distance between ways, 7¾ inches; depth of throat, 8 inches; diameter of fly wheel, 30 by 4½ inches; net weight, 2,500 pounds.

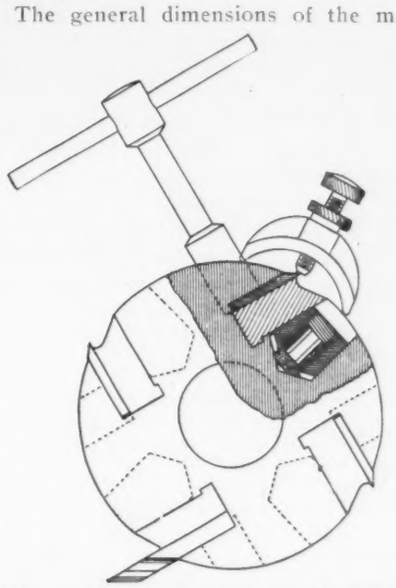
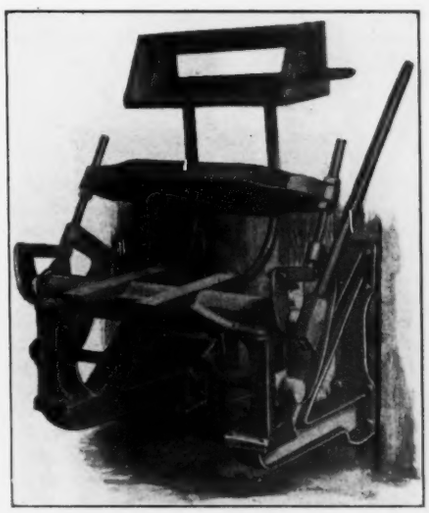


FIG. 2—METHOD OF SETTING KNIVES IN SAFETY HEAD

BETTER PROTECTION FOR JOINTER OPERATORS.

So many expensive damage suits result from improperly guarded woodworking machines that shop owners are constantly looking for every efficient means of protecting their workmen. The modern factory owner takes pride in providing every possible protection to his employes, because he realizes that lawsuits must be paid for out of the profits of the business. Many woodworkers would have more fingers today had the jointers, on which they worked, been provided with a safety device.

A very serviceable device of this kind



WALL TYPE, FARWELL SQUEEZER

is the round head for jointers, made by the Crescent Machine Co., Leetonia, O., shown in Figs. 1 and 2. The construction of this head is such that the knives are securely wedged in place and the centrifugal force has a tendency to hold them tighter. They have a bearing the entire length and are tightly gripped the full width to the extreme cutting edge, the means of adjustment being very convenient and effective. Extra throat pieces are also furnished, so that molding cutters and special knives of any kind can be used.

A NEW FARWELL SQUEEZER.

A new type of Farwell squeezer, manufactured by the Adams Co., Dubuque, Ia., designed to attach to the wall instead of being mounted upon legs, is shown in the accompanying illustration. This is a 30-inch machine, that is, 30 inches between the side rods, but is built in 24-inch, 34-inch and 38-inch sizes. The principal advantage of this type is

that it occupies very little space, and when floors are crowded, makes it possible to put up one or two more rows of molds. This machine is not intended to take the place of the stationary Farwell squeezer, or any of the other types, but is a special design, suitable only for certain conditions, and is not expected to be used on long floors, where considerable space is covered with molds and where a day's work is poured off at one time. It is a very handy machine for malleable foundries and other shops where a heat is taken off several times a day, or where pouring is continuous.

Brass foundries that use squeezers, will find this bracket type very convenient, as, being suspended from the wall, the space beneath is clear and allows free play for the shovel, so that the spilled sand can be easily and constantly used before it has a chance to dry out.

This style of bracket machine was originally designed by K. J. Carroll,

ALTERNATING CURRENT CONTROLLER

superintendent of the National Malleable Castings Co.'s foundry, Cleveland. This concern at first bought a large number of squeezers without legs and added the brackets. The addition of these four sizes of bracket squeezers increases the number of molding machines manufactured by the Adams Co. to 72 styles and sizes.

ALTERNATING CURRENT CONTROLLERS.

Electrically-driven cranes and mill machinery were until quite recently, almost exclusively operated by direct current motors. Within late years, however, the flexibility and ease with which alternating current may be transmitted, has resulted in a large and increasing use of alternating current motors for such machines.

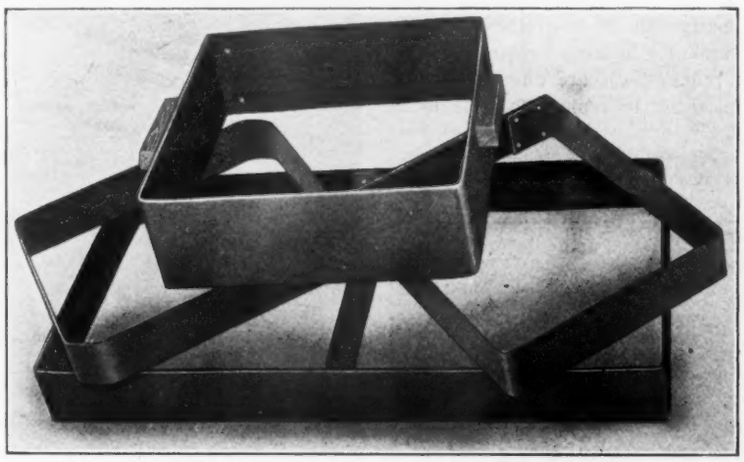
The controller, shown herewith, is made by the Electric Controller & Mfg. Co., Cleveland, which has developed a comprehensive line of manually operated controllers for slip ring, alternating current motors from one to 100 horsepower. These controllers follow as closely as possible in design and construction the direct current controllers which this company has been manufacturing, and wearing parts of alternating and direct current controllers are interchangeable, to a large extent.

One desirable feature of the direct current motor for crane and mill machinery is its high starting torque. In the alternating current motors this feature is more nearly found in the slip-ring than in the squirrel cage type, therefore the development of the alternating current motor for reversing work has leaned heavily towards the use of the slip ring motor. Speed and torque control are obtained by inserting and varying resistance in the secondary winding of the motor.

The controller shown is for use in connection with either two-phase or three-phase, reversing slip ring motors, and the resistance is entirely self-contained, it being necessary to connect only seven leads to the controller. For heavy currents, cast grid resistance is employed. Short circuiting by mill dust has been guarded against, and the wearing parts have been designed so that the user can replace them in his own repair shop. The operation of these controllers is by a lever motion, which is considered advantageous for crane and mill service.

STEEL BANDS AND SLIP JACKETS FOR SNAP FLASK MOLDS.

The accompanying illustration shows different styles of steel bands and slip jackets manufactured by the Diamond Clamp and Flask Co., Richmond, Ind., to take the place of heavy cast iron bands and wooden slip boxes generally used in foundries. The bands are ⅛ inch thick and are made in sizes 1½ inches, 2 inches, 2½ inches and 3 inches deep. They are light, easy to handle, and can be subjected to severe usage without breaking. The slip jackets are made of No. 12 gage steel, and are provided with wooden handles at each end.



STEEL BANDS AND SLIP JACKETS FOR SNAP FLASK MOLDS

THE TUSCORA SAND CO.

The Tuscora Sand Co., Williamson building, Cleveland, is offering to the foundry trade several different grades of molding sand mined at Somerdale, O., where a tract of 160 acres has been acquired. These banks contain all of the various grades of molding sands required for foundry work and are especially adapted for producing brass, iron or steel castings. For the rerolling, crushing and blending of sands, a large plant is now being erected to meet every requirement of the foundry trade. The power plant has already been built and the sand preparing plant promises to be one of the largest in the country.

TRADE NOTES.

The H. W. Johns-Manville Co., 100 William street, New York City, is sending to dealers an 8-page circular containing forceful and convincing advertisements of the roofing manufactured by this concern.

The United States Reduction Co., in a circular recently issued, announces the removal of its works to its new plant at East Chicago, Ind., and the offices have been removed to 505-506 Manhattan building, Chicago.

The Kerr Turbine Co., Wellsville, N. Y., is building eight 50-horsepower, 7-stage, vertical turbo-fans for supplying forced draught to the boilers of the United States torpedo boat destroyers Sterrett and Perkins.

The Homogen department of the Al-

ne Brass Foundry Co., Cleveland, is nding to the brass foundry trade a rcular containing testimonial letters om foundrymen, who have successfully ed Homogen in their brass mixtures.

The Independence Mfg. Co., Philadelphia, recently incorporated, will engage in the manufacture of core oils for foundry use. This concern is well equipped to manufacture core oils of various grades and its plant has a large producing capacity.

Circular No. 105, 16 pages, recently issued by the Adams Co., Dubuque, Ia., contains instructions for the operation of Farwell squeezers. Much practical advice for the foundryman is also included, as well as instructions for making metal match-plates.

The Metal Dross Economy Co., Bristol, Conn., is sending to the trade a 10-page circular, illustrating and describing its process of skimming and recovering metal drosses. In addition, a dross separator is shown. A large number of testimonial letters are also reproduced.

The S. Obermayer Co., Cincinnati, manufacturer of foundry facings, supplies and equipment, has furnished the complete foundry equipment for the battleship Dixie. This portable foundry was installed to facilitate repairs while the ship is at sea.

The Hanna Engineering Works, Chicago, in a 4-page circular, describes its extensive line of pneumatic riveters and punches. In addition, motor-driven and pneumatic shakers are shown, as well as a portable mold dryer for skin drying molds. The circular is well illustrated.

The Globe Stove & Range Co., Kokomo, Ind., has recently extended its plant and has installed a Newten cupola of 14 tons hourly capacity, as well as a complete industrial railway, including ladles and trucks. This equipment was furnished by the Northern Engineering Works, Detroit, Mich.

The James Brady Foundry Co., Thirty-fifth street and Ashland avenue, Chicago, has recently installed a three-motor, alternating current electric traveling crane of 10 tons capacity and 41-foot span. This is the second crane of this type furnished this concern by the Northern Engineering Works, Detroit.

The W. S. Rockwell Co., 50 Church street, New York City, in a 4-page circular, describes its reverberatory melting and refining furnace, which is adapted for melting and refining drosses, reducing copper and brass wire and miscellaneous scrap to ingot form. It is also suitable for melting lead, tin, zinc, etc., in large quantities.

The Northern Engineering Works, Detroit, reports the following recent shipments of Newten cupolas: Specialty Foundry Co., Zelienople, Pa., 12 tons capacity per hour; Ford Motor Co., Detroit, two, 9 tons capacity each; Massey Gin & Machine Co., Macon, Ga., 5 tons capacity; Hamden Foundry Co., 3 tons capacity, and Orville Pump Co., 7 tons capacity.

The Pawling & Harnischfeger Co., Milwaukee, is sending to the trade a 6-page folder containing a brief description of its line of horizontal drilling and boring machines. These are made in several types and are recommended for every class of work where drills from 3/8 inch to 3 inches are used. A partial list of concerns using these drills is contained in this circular.

The Vernon Metal Co., Hudson Terminal building, 30 Church street, New York City, announces that it is in position to make prompt deliveries of No. 1 Virgin aluminum in the form of notched ingots in any quantity to meet consumers' requirements. This concern is also offering an aluminum alloy consisting of aluminum, 92 per cent, and copper, 8 per cent, which is highly recommended for casting purposes.

The M. R. V. furnace, manufactured by J. B. Wise, Watertown, N. Y., which is of the tilting type, equipped with a self-contained crucible, and using coke as fuel, has recently been installed in the following plants: Nelson Valve Co., Chestnut Hill, Pa., six furnaces; Nathan Mfg. Co., New York City, seven; Pratt & Cady, Hartford, Conn.; Hyde Windlass Co., Bath, Me.; Walworth Mfg. Co., Boston; Bay State Brass Co., Haydensville, Mass.; A. P. Smith Co., Newark, N. J.; J. H. White, Brooklyn, N. Y.; Tuttle & Bailey, Brooklyn, N. Y.; Transit Supply Co., Minneapolis; Exeter Machine Works, Pittston, Pa. Installations have also been made in a number of other plants.

TRADE PUBLICATIONS.

GAS COMPRESSORS.—The Ingersoll-Rand Co., 11 Broadway, New York, has issued a 32-page catalog which illustrates and describes its extensive line of gas compressors.

CHAIN HOISTS.—The Ford Chain Block Co., Philadelphia, in a 12-page circular, illustrates and describes its "Tribloc" hoist, which is made to meet all requirements of severe service, all working parts being made of steel, the hooks being drop forged and the chains hand welded and tested. These hoists are made in sizes ranging from one-half to 20 tons capacity.

THE MILWAUKEE SNAP FLASK.—The Charles Jurack Pattern & Foundry Supply Mfg. Co., Milwaukee, Wis., in an illustrated folder describes the Milwaukee snap flask. This is a strong and durable flask, the trimmings being of malleable iron, the edge, top and bottom of steel, and the corner irons are fitted with ears, which clasp the sides of the flask inside and out, and being securely fastened, prevent all possibility of the corner plates working loose. The pins and plates are made to secure an even lift, and are adjustable. The locking device comes together, iron to iron, this construction making it practically an iron flask. The wood used in its construction is either maple, ash, oak or cherry, and the flask is built to withstand hard usage.

ROLLING DRAWER CORE OVENS.—The J. D. Smith Foundry Supply Co., Cleveland, in a 12-page pamphlet recently issued, describes its core oven installation in the plant of the Ferro Machine & Foundry Co., Cleveland. These ovens are located on the second and third floors of the core shop and are fired from the first floor. On the third floor are two batteries, back to back, but separated about 4 feet, and each battery consists of eight ovens containing six drawers each, 34 inches wide and 60 inches long. Each battery is 34 feet 4 inches long. The two batteries on the second floor contain four ovens each, arranged back to back, as on the third floor, and each oven has five drawers, 34 inches wide and 60 inches long. These two batteries are each 17 feet 4 inches long and contain 40 drawers, so that the total installation contains 136 drawers, or 1,924 square feet of baking surface.

ELECTRIC HOISTS.—The Sprague Electric Co., New York City, in Bulletin 233, recently issued, describes its extensive line of electric hoists which are designed to handle loads that are inaccessible to the ordinary traveling crane, or which are too small to be economically handled by overhead conveyors. The type S-7 hoists have a maximum lifting capacity of one-half ton at a speed of 15 feet per minute. These hoists are adapted for brass foundry use. Another hoist is adapted for loads ranging from one-half to four tons, and is especially applicable to foundry work and for use in exposed locations. The S-2 and S-3 hoists are adapted for loads of two, three, four or six tons. When carrying molten metal, these floor-operated hoists can be equipped with outriggers, to enable them to be controlled some 3 or 4 feet away from the hook, thus enabling the operator to work in comfort. Bulletin 516 describes the flexible, steel-armored hose for compressed air or steam.

NEWTEN CUPOLA.—The Northern Engineering Works, Detroit, has issued a 12-page catalog illustrating and describing its Newten cupola. This cupola is equipped with the patent differential tuyere system, in accordance with the latest theories of modern cupola practice. A sectional plan through the lower tuyeres is shown, outlining their shape and arrangement and indicating the tendency of the blast to reach the center of the cupola. The safety tuyere and the blast entrance are tangential in two directions, which tends to evenly distribute the blast on both sides of the furnace. Large cleaning doors, fitted with mica peep holes, are located opposite each tuyere and afford ready access for cleaning and inspection. Both the cleaning doors and peep holes have planed and fitted joints with adjustable fastenings, so that the air chamber is permanently air tight, even under the severe conditions of expansion and contraction to which they are subjected. This results in economy of air and consequent high melting speed.

GENERAL INDUSTRIAL NOTES

The Wason Mfg. Co., Springfield, Mass., will erect a foundry, 40 x 125 feet.

T. McAvity & Sons, St. John, Can., contemplate the erection of a large addition to their plant.

The Rock Island Mfg. Co., Rock Island, Ill., has prepared plans for a large extension to its foundry.

The Sternberg Foundry & Supply Co., Asheville, N. C., contemplates the erection of a machine shop and foundry.

The Becker Mfg. Co., Two Rivers, Wis., is erecting a foundry, 40 x 60 feet. A four-ton traveling crane will be installed.

The Corbett Foundry & Machine Co., Owen Sound, Can., will extend its plant by the erection of a large foundry and machine shop.

The Wisconsin Foundry Co., Milwaukee, Wis., is building an addition to its foundry, 80 x 84 feet, and will install another crane and a cupola.

The Acme Shear Co., Bridgeport, Conn., manufacturer of cast shears and scissors, will erect a foundry, 50 x 80 feet, and a coke storage, 26 x 50 feet.

The Keystone Enameling Co., Pittsburg, will erect an enameling plant on the Allegheny river, near Sharpsburg, Pa. This concern is capitalized at $125,000.

The E. L. LeBaron Foundry Co., Bridgewater, Mass., manufacturer of gray iron castings, will erect a new foundry to replace the one recently destroyed by fire.

The Belknap Iron Foundry, Laconia, N. H., of which James McGloughlin is proprietor, will be 59 x 150 feet. This shop will replace the plant destroyed by fire several months ago.

The Wehr Steel Co. has been organized at Milwaukee and a crucible steel casting foundry will be erected at West Allis, where a foundry 100 x 200 feet, equipped with eight oil furnaces, will be built.

The Gas Traction Foundry Co., Minneapolis, will erect a foundry, 80 x 132 feet, for the manufacture of gray iron castings for gas and gasoline engines. A pattern shop, 25 x 80 feet, will also be built.

The West Steel Casting Co., Cleveland, manufacturer of steel castings, is making further additions to its plant and will install new equipment to increase its output of crucible and converter steel castings.

A factory for the manufacture of sheet metal parts for stoves, containing 200,000 square feet of floor space, will be added to the plant of the Quick Meal Stove Co., St. Louis, a branch of the American Stove Co.

The Farrell-Cheek Steel Foundry Co. will erect a steel casting plant at Sandusky, O. The plans have been prepared by the Osborn Engineering Co., Cleveland, and T. H. Brooks & Co., Cleveland, have been awarded the contract for the structural steel work.

Sweet Bros., Lestershire, N. Y., are replacing their gray iron foundry, recently destroyed by fire, with concrete buildings. The foundry will be 36 x 90 feet, and the power plant and cleaning room, 30 x 90 feet. A pattern storage vault, 12 x 12, is also being erected.

The Western Foundry & Iron Co., Wichita, Kans., contemplates the erection of a two-story building, which will be used as a foundry. The present casting plant will be converted into a structural fitting shop. New equipment will, however, not be purchased until early next year.

Plans for the large foundry to be built for the Universal Caster & Foundry Co., Newark, N. J., have been completed by F. H. Ogden, consulting and designing engineer, Newark. The plant will be erected on a site, 400 x 600 feet, and will consist of 12 buildings. The entire cost, including equipment, will be approximately $200,000.

The George Cutter Co., South Bend, Ind., is erecting a foundry, 145 x 242 feet, of steel and brick construction. Poles and brackets for street lighting lamps will be cast. William H. Holland, formerly president of the Sibley Machine Tool Co., has acquired an interest in the George Cutter Co. and will be identified with the management.

The Modern Foundry Co., Oakley, Cincinnati, O., will practically double its molding floor space during the next 60 or 90 days. The Cincinnati Milling Machine Co. will move out of the Modern Foundry Co.'s building within the next 60 or 90 days. In addition, this plant is to be extended by the erection of a new shop, plans for which have not as yet been definitely decided upon.

The Northern Pacific Railway Co. is erecting a foundry at Brainard, Minn., which will have a daily capacity of 50 tons of gray iron castings and six tons of brass castings. The foundry will be 120 x 320 feet, pattern shop, 50 x 80 feet, and pattern storage building, 50 x 80 feet, four stories high. The main bay of the foundry will be equipped with a 10-ton traveling crane, as well as 25-ton jib cranes. The side bay will be commanded by a two-ton traveling crane.

David Brown & Sons, Ltd., Huddersfield, England, are transferring their East Parade Pattern Works to Lockwood, where new shops covering an area of 14,000 square feet are being erected, adjoining the foundry and gear works operated by this concern. The new shop will be equipped with modern wood-working machinery and an extensive pattern storage plant, drying sheds and lumber yard will be provided. At the present time 100 pattern-makers are employed, engaged on all classes of work, from motor patterns to large marine turbines.

The United Engineering & Foundry Co., Pittsburg, will discontinue the production of gray iron castings at the Phelps street plant of the Lloyd-Booth department, Youngstown, O., and will concentrate its foundry production at its Oak street plant in the same city. The capacity of this plant will be extended, and when additions are completed the molding floor will contain about 80,000 square feet, and the output of iron castings and rolls will be approximately 24,000 tons per annum. A coke and pig iron storage yard will be added, covering 22,000 square feet, which will be served by a 25-ton traveling crane. The present foundry of the Phelps street plant will be converted into a machine shop. The changes will be completed in August.

A new plant for the production of gray iron castings is being built by the Commercial Foundry, 93 Meldrum avenue, Detroit. The plant will be ready for operation about the middle of June. The shop is 120 x 60 feet, and in an adjoining building are located the core room, cupola house, lavatory, cleaning and shipping departments. The Wisconsin Bridge & Iron Co., Milwaukee, has been awarded the contract for the steel work, the plant having been designed by W. T. Curtis, 505 Moffat building, Detroit. The Commercial Foundry has been organized by Benjamin Middleditch, and with him is associated S. A. Laffrey, who has been appointed manager of the plant. A specialty will be made of the production of gray iron castings for automobile work.

Among the Brass Foundries.

The Eastern Metal & Refining Co., Boston, Mass., manufacturer of brass ingots, is enlarging its plant.

The Gray-Hawley Mfg. Co., Detroit, manufacturer of automobile accessories, will erect a brass foundry.

Henry Wray & Son, Inc., Rochester, N. Y., brass founders, will erect a new brass foundry and machine shop.

The Cramer & Kiely Brass Foundry Co., Syracuse, N. Y., was recently organized to carry on a jobbing brass foundry business.

The Van Doren Mfg. Co., Chicago Heights, Ill., manufacturer of steel fishing rods and similar goods, will erect a brass foundry.

The Packard Automobile Co., Detroit, Mich., is adding a brass foundry for the manufacture of castings required in the construction of its motor cars.

The Fletcher White Metal Co., Edgewater, N. J., has recently incorporated for $100,000 to engage in the manufacture of a patented white metal.

The David Bradley Mfg. Co., Hartford, Wis., will operate a brass foundry in the plant of the Hartford Plow Co., recently purchased by this concern.

The Prier Bros. Brass Co., Kansas City, Mo., has recently increased its capital stock, in order to take over the Central Brass Works, of that city.

The Woonsocket Machine & Brass Co., Woonsocket, R. I., will erect an addition to its foundry, 65 x 150 feet, to provide increased molding floor space.

The American Brass Co. is planning for the expenditure of from $1,000,000 to $3,000,000 to be expended in the extension of the plant of the Chicago Brass Co., Kenosha, Wis.

The William Powell Co., Cincinnati, is planning an addition to its brass foundry, 50 x 200 feet, two stories, to be located in the rear of the main plant, on the west side of Spring Grove avenue.

The Hess-Snyder Co., Massillon, O., is enlarging its plant by the erection of a foundry, 80 x 162 feet. Considerable new equipment will be installed, including a 10-ton electric crane.

The Belknap Mfg. Co., Bridgeport, Conn., will build an addition to its works, 25 x 85 feet, one story, to increase its facilities for the production of brass goods for steam, gas and water.

The American Ornamental Iron & Bronze Co., Minneapolis, Minn., is making extensive alterations in the foundry and shop buildings recently secured, and modern equipment will be installed.

The North & Judd Mfg. Co., New Britain, Conn., manufacturer of saddlery hardware, will erect an addition to its brass foundry, 60 x 105 feet, and an addition to its annealing room, 70 x 94 feet.

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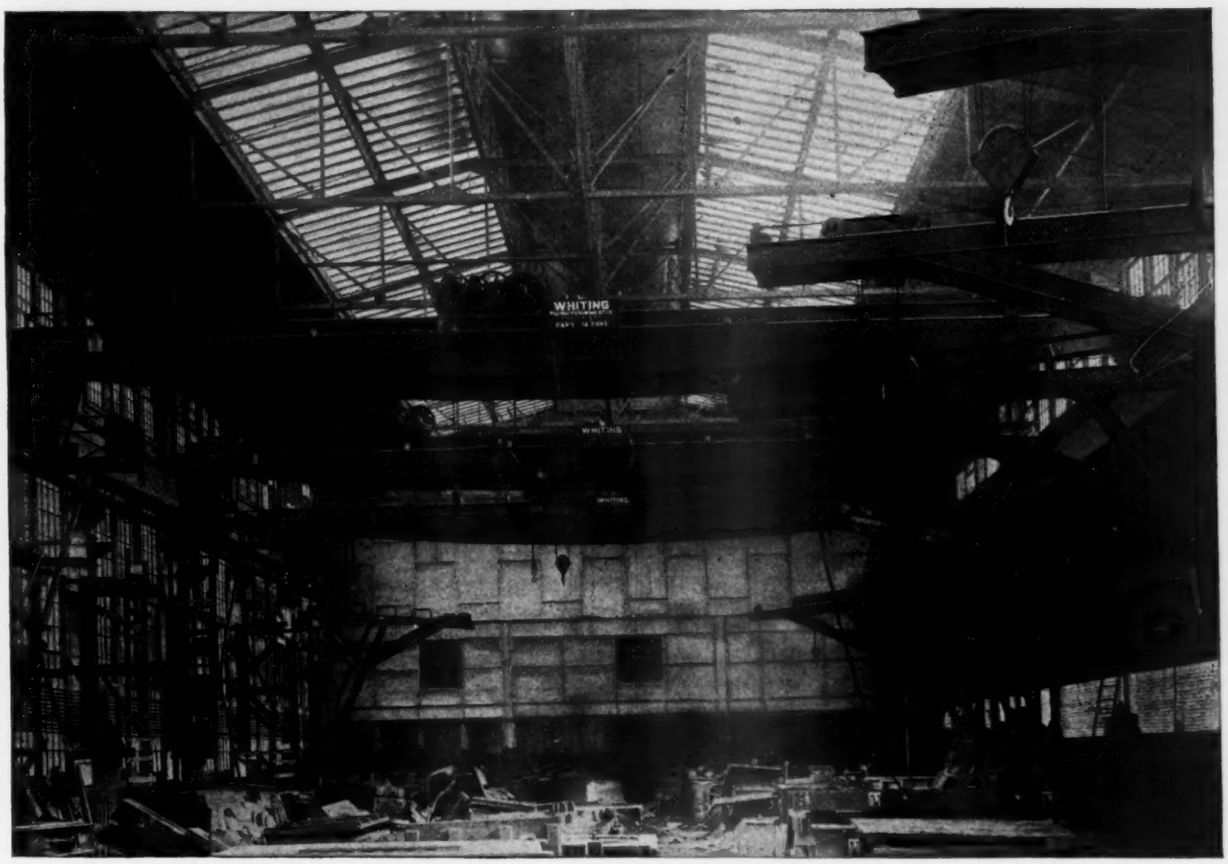

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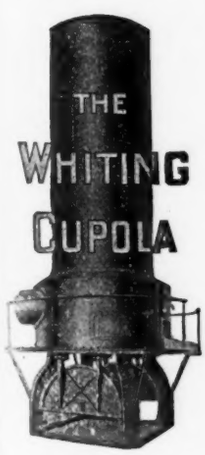

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